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# Engineering and Mining Journal

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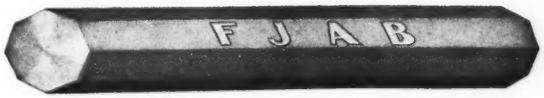


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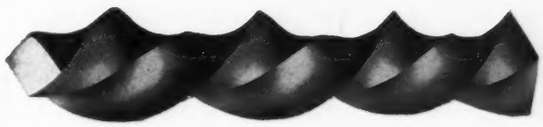

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# The S-A Page

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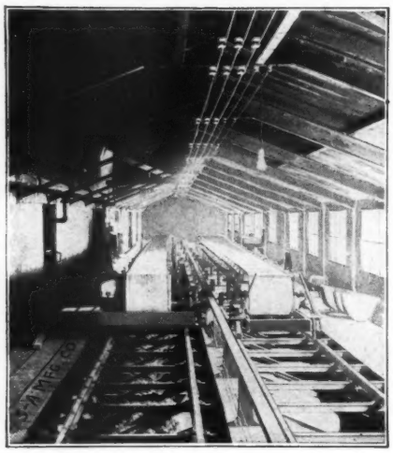

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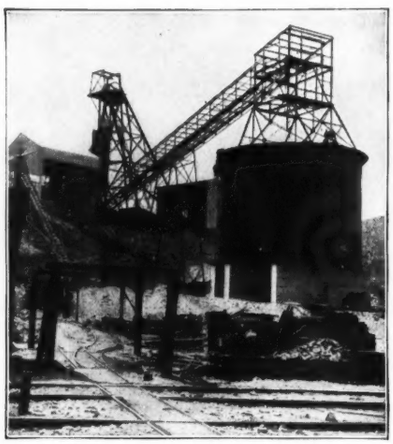
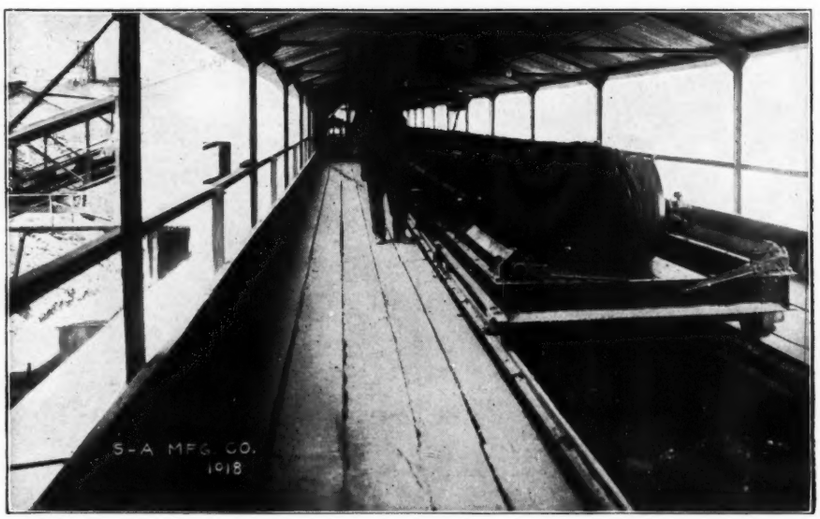


Construction photograph of a 42-inch by 266-foot conveyor carrying ore from the crushing plant to the bins.

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Engineering and Mining Journal

VOLUME 102 AUGUST 12, 1916 NUMBER 7

# Exploitation of Chilean Mines

By Benjamin L. Miller* and Joseph T. Singewald, Jr.†

*SYNOPSIS—Huge investments of foreign capital in equipment for mining low-grade ore deposits have been object lessons to native Chileans. The mining laws of Chile are good. Transportation problems have been minimized by recent railway construction. The labor supply is ample and of good quality. Chile is likely to again rank second among the world's copper-producing countries. An American company will soon ship 1,000,000 tons annually of high-grade iron ore. Old silver mines may be profitably reopened.*

Among the countries of South America, Chile has for many years particularly appealed to the mining profession because of the richness and variety of its mineral wealth. Since the recent development of its enormous deposits of low-grade copper ores and high-grade iron ores by American capital, and with the universal appreciation, since the outbreak of the European War, of the value of the monopoly in natural nitrates, interest is now more than ever directed to the "shoestring" country of the west coast of South America. With a length of about 3,000 mi. (four times as long as California and less than twice as great in area), the country is unique in the wide-spread distribution of its mineral wealth. In the extreme south are the placer gravels of Tierra del Fuego and the coal deposits of Punta Arenas, while in the far north are the sulphur and borax workings of the high Andes. From the Straits of Magellan to Valdivia the bleak climate has discouraged the prospector, and much of that region is uninhabited and practically unknown, yet the fact that gold-bearing sands are found at many points leads one to believe that section has also been extensively mineralized. Most of the mining, however, has been carried on in the central and northern portions of the country, extending from Concepcion, near which place the principal coal mines are located, to the Peruvian boundary, a distance of about 1,400 mi.

Chile owes its vast metallic mineral wealth mainly to its igneous rocks, which form such a large portion of the land, and its nonmetallic deposits to unusual climatic conditions. Sediments of Jurassic and Cretaceous age have been intruded by batholiths, stocks and dikes of igneous rocks of various kinds and are in other places interbedded with flows of lavas. Mineral solutions accompanying the igneous rocks have resulted in the formation of the rich deposits of minerals. Among the important nonmetallic products the nitrates, guano and borax deposits, all soluble and hence easily removed by solution, owe their origin to the extremely arid conditions that for centuries have prevailed in the northern portion. The nitrates and borax are the result of long-continued concen-

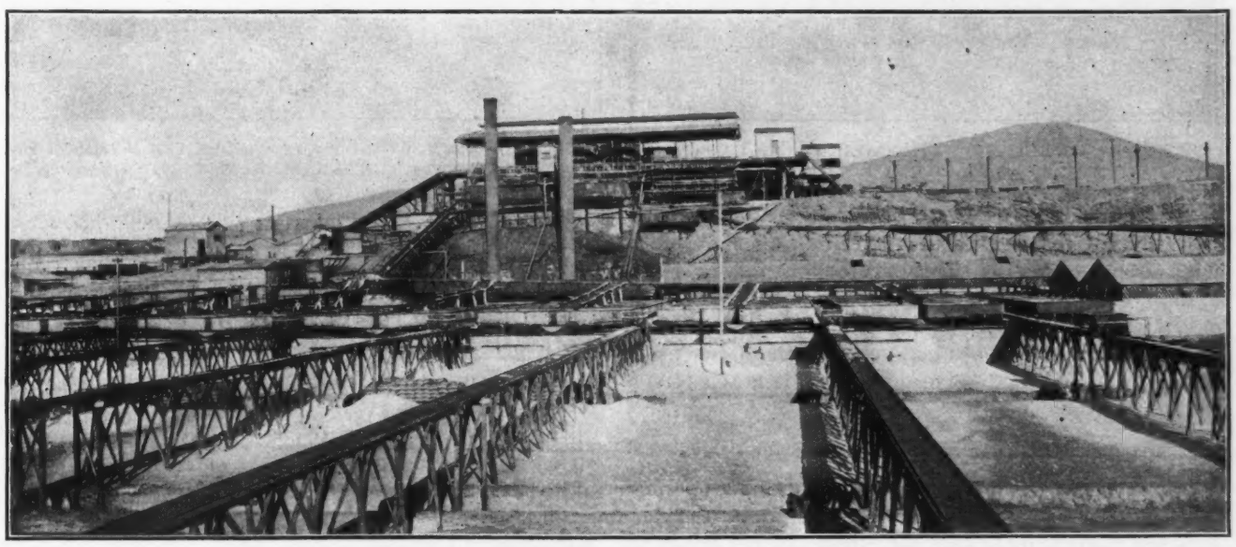


FIG. 1. NORTH LAGUNAS OFICINA, A TYPICAL NITRATE EXTRACTION PLANT

*Professor of geology, Lehigh University, South Bethlehem, Penn.

†Associate in economic geology, Johns Hopkins University, Baltimore, Md.

tration by precipitation from dilute solutions through evaporation.

The mining industry of Chile has passed through several fairly distinct stages. Before the coming of the Spaniards both the Inca and the Araucarian Indians had developed some of the gold and copper mines. Under the régime of the Spaniards the mines produced enormous amounts of silver and also much gold. When the country finally secured its independence in 1826, the mining of copper and silver were of prime importance, while soon after the exportation of nitrate commenced. Since then the output of these three products has continued, but with a gradual decline in the production of copper and silver, as the mines increased in depth and pyritic ores were encountered, while nitrate production has increased. Within recent years a new epoch in the mining industry of Chile may be said to have started with the introduction of large amounts of North American capital to the development of the iron and copper mines.

Under the control of the native Chileans it was unusual to spend much money in the equipment of a mine. When bonanza orebodies were encountered the suddenly enriched mine owners lost all interest in low-grade ores, and when the rich pockets were exhausted, they retired from mining. The ore reserves are, however, so extensive that one can predict many years of active mining before this condition is reached. Nevertheless, the policy of the Chilean government has been to make hay while the sun shines, and consequently it has levied heavy export taxes on nitrate, iodine and borax, while the repeated agitation for similar taxes on copper and iron ore lead one to believe that these products will also be called upon to bear their proportion of the expenses of the government before many years, although as yet they have escaped. As the country possesses a monopoly in its nitrate, the export tax does not materially affect the operating nitrate companies. The government can be depended upon to treat the other mining companies fairly and not impose confiscatory taxes. The mining companies must always suffer more from the almost universal "graft" that permeates all branches of the government than from the laws. In every mining district throughout the country one hears the same kind of stories of petty persecutions inflicted upon the companies by prefect, judge, sub-prefect, carabineros, etc.

The mining laws of Chile are very definite and seldom is there much litigation regarding titles. The government requires on each mining claim a yearly tax which amounts to 10 pesos (1 peso equals $0.36 U. S. currency) a hectare

FIG. 2. MINING NITRATE CALICHE AT LAGUNAS OFICINA

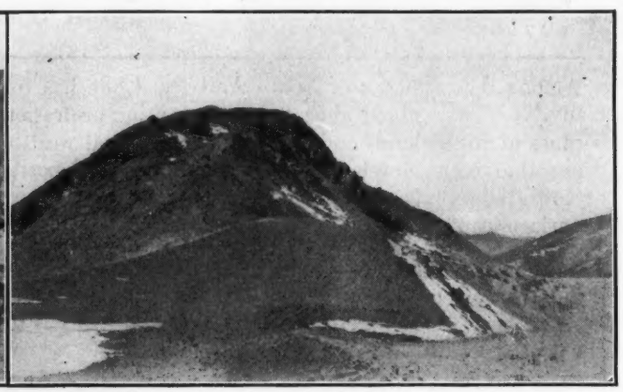


FIG. 3. SUMMIT OF MT. OLCA, ELEVATION 18,500 FT., WHERE SULPHUR IS MINED

It has been an object lesson to Chileans, therefore, to see the millions recently invested in the Braden and Chuquicamata copper mines and in the Tofo iron mines. If the example set by these companies in large initial investment of capital in development and equipment is followed, many of the abandoned *antiguas* may regain their former prominence through their reserves of low-grade ores receiving the attention they merit.

### Mines Exploitation Enriches Foreigners

It has been the good fortune of Chile to attract foreign capital to develop her mineral industries and at the same time her misfortune to have the product of her mines enrich the citizens of other countries. For a number of years the largest mines have been in the possession of foreigners, and this condition is likely to continue. Most of the nitrate companies are owned by English capital, with the German, French and American interests also extensive, while the leading copper and iron mines are financed by American capitalists. Native capital has been insufficient properly to develop the mines or too timid to take the necessary risks, and yet the Chilean cannot fail to look forward with apprehension to the time when the foreigner will have exhausted the mines and withdrawn.

(2.471 acres) in the case of metallic ores and less for the nonmetallic. With the exception of deposits of nitrate, salt, guano and coal, the discoverer of any ore deposit can acquire possession by denouncement whether the land is privately owned or belongs to the state. In the first case, however, the original owner must be paid for any damage done to his property during mining operations. Coal deposits belong to the owner of the land, while guano, nitrate and salt deposits belong the the state and are sold at auction. Foreigners enjoy the same rights as citizens in the acquisition of mining property.

The transportation problem in Chile has never been as serious as in many of the other Latin-American countries, because all portions of the country are comparatively close to the ocean. No doubt railroads would have been constructed in greater numbers if the country had not been so well favored by water transportation. The first railroads were built to connect inland mining camps or inland cities, such as Santiago, with the nearest seaports, and there are many lines of this kind. The need of a longitudinal railroad, however, had long been felt, and for many years a line from Valdivia in the south to Arica in the north has been under construction. It has now been completed from Valdivia almost to Iquique, and in a few

years will certainly be extended to Arica. As the line crosses at right angles the valleys of all the streams that flow from the high Cordillera to the ocean, its building was very expensive and in many places the grades are so steep that the rack system must be employed. During 1915 trains were run over portions of the line only once a month. The annual deficit of the whole line is large, yet many of the smaller mining camps which were previously without railroad facilities have been greatly benefited and the country as a whole profits by the enterprise. The northern part of the line passes through the desert section, where vegetation is scant or lacking, so that it may be said to have been built for the mining industry alone.

The labor conditions in the mines of Chile are somewhat different from those prevailing in other Latin-American mining camps. The laborers are the descendants of the early Spanish and the Indians, and so thoroughly have the two races intermingled that one seldom sees marked Indian characteristics except in the natives of southern Chile, where some of the Araucarians have kept their race fairly pure. The Chilean *roto* is strong, willing, and develops into a good miner. He is improvident and reckless, consequently always poor, yet orderly except when drunk. Liquor is the curse of the mining districts, and after each holiday (and numerous holidays there are) the *roto* is unfit for his usual labor for several days.

In a general summary of the mining industry only the chief products can be mentioned. In order of importance among the metallic substances are copper, iron, silver and gold, and among the nonmetallic are nitrates and iodine, coal, borax and sulphur.

### Copper Production Will Rank Chile Second

Chile has long attracted the attention of the mining world because of its vast copper resources. It is said that the Spaniards began mining copper in 1601 and that the country has ever since had copper mines in operation. For many years it held first place among the copper-producing countries of the world, being surpassed for the first time in 1882 by the United States. In recent years Chile's copper production has been exceeded by several countries yet there is little doubt but that it will soon regain second place. The maximum output was reached in 1876 when the country produced 46,422 tons.

According to the statistics in 1913 there were 12,403 copper-mining claims that had been denounced aggregating 41,879 hectares, besides 686 silver and copper claims and 641 gold and copper claims, making an aggregate of 13,730 copper properties. These claims are widely distributed throughout the central and northern portions of the country but are mainly contained in the provinces of Tarapaca, Antofagasta, Atacama, Coquimbo, Aconcagua, Santiago and O'Higgins. The first four lie within the desert portion of north Chile, while the last three are in the semi-arid region where agriculture and horticulture rank in importance with mining. When the Chuquicamata plant reaches the capacity planned for it of 40,000 tons a day, the Braden Copper 6,000 tons, and the Anaconda Copper Co. develops its recently acquired extensive holdings in the Potrerillos field, Chile will surely again become the world's second greatest copper producer.

One of the most interesting and distinctive features of the Chilean copper deposits is the presence, in commercial quantities, of large bodies of minerals seldom seen in the other copper regions of the world. Among these are atacamite, brochantite, copiapite and chalcanthite, all of which owe their origin to the extremely arid condition of the regions where they occur. The saving of these minerals has called for new methods of treatment by leaching that are being introduced in several places, but most elaborately at Chuquicamata.

### Iron Mines Little Developed

That Chile contains extensive deposits of high-grade iron ore has long been known, but until the advent of American capital little progress was made in their development. The best deposits are found in the provinces of Antofagasta, Atacama and Coquimbo. The ores are mainly hematite and are low in phosphorus.

In spite of the fact that the Chilean government has long offered special inducements for the establishment

MAP OF CHILE, SHOWING MINING DISTRICTS

of iron and steel works, the iron ore smelted in the country is insignificant in amount. A French company, the Société Française des Hauts-Fourneaux du Chili, accepted unusual concessions from the government and opened the Tofo mines north of Coquimbo and built large smelting works at Corral in southern Chile, but becoming involved in labor, financial and political difficulties the company closed down in 1911 and later disposed of its mines to the Bethlehem Steel Co. This company is spending about $8,000,000 in improving the property preparatory to shipping 1,000,000 tons of ore a year, but all the ore leaves the country and Chile must still import its iron and steel.

Chile has had some of the richest silver mines ever discovered. The Chañarcillo mines, about 60 mi. south of Copiapo, and the Huantajaya mines, near Iquique, furnish

ideal illustrations of bonanza mines. The latter were extensively worked to the close of the Eighteenth Century and were later allowed to remain idle until 1873, but are at present in operation. They are said to have produced more than $22,000,000 worth of silver. The Chañarcillo mines were discovered in 1832 and during the succeeding 30 years produced a great amount of wealth. The Caracoles district, 110 mi. east of Antofagasta, was another famous silver district and also Los Tres Puntos, near Copiapo. The principal silver output now comes from the Huantajaya mines and some others near Taltal. The production has been steadily decreasing for many years until it is now of minor importance, yet there are mining men in the country who firmly believe that it would be profitable to reopen some of these abandoned mines.

To the close of 1915 Chile had produced but $314,000,000 worth of silver, while the present production amounts to about $500,000 a year.

For many years little attention has been given to the gold deposits of Chile, yet the country has had many profitable mines at different times. Up to the present the gold mines have yielded about $224,000,000 and are still producing at the rate of between $200,000 and $300,000 a year.

Gold placers are widespread and in the early history of the country produced most of the gold. The Madre de Dios, near Valdivia, and the Malga Malga, between Santiago and Valparaiso, were two of the earliest and also the richest mines worked. Placers in the southern portion of the country continue to produce some gold, although the dredging operations near Punta Arenas have not been successful, but the chief productive gold area, containing both placer and lode workings, lies between Santiago and Coquimbo. The most important mines are located near San Felipe, Los Valos, Talca, Ovalle and Cachinal. In addition considerable gold is obtained from copper ores.

### Nitrates Backbone of Government Revenue

In most countries the deserts are looked upon as waste land, but the arid regions of northern Chile constitute the most valuable portion of the country. The export tax on the nitrates from these desert sections amounts to over $30,000,000 a year and furnishes about 70% of the government's revenue.

The nitrate deposits occur in a series of basins, or pampas, lying between the coast ranges and the higher Andes to the east and extending in a north-south direction from Taltal to Pisagua, a distance of about 450 mi. Seldom has a country obtained such a rich war indemnity as fell to Chile when, in 1879, at the close of her war with Bolivia and Peru, she acquired the rich provinces of Antofagasta, Tarapaca and Tacna. By the terms of the treaty of peace a plebiscite was to be held some years later to determine the final status of the former Peruvian provinces of Tarapaca and Tacna, but Chile has declined to call for the vote and has shown plainly that she will never relinquish her hold on this territory except by force.

Frequent reports are spread concerning the rapid exhaustion of the nitrate fields, but these fears have little foundation. While during the last few years somewhat more than 2,500,000 tons has been exported annually, it will be recalled that in 1908 the government inspectors reported the known reserves as 220,000,000 tons, and later investigations greatly increase these figures. Improved methods of extraction by plants similar to that illustrated in Fig. 1, by which lower-grade caliche can be used, also tend to conserve the supply. In the earliest workings only the caliche containing upward of 55% of sodium nitrate was taken. In the Agua Santa region some ground is to be worked over for the fourth time and all the earth containing 10% of nitrate will be utilized. It is probable that even lower-grade rock will eventually be used. Fig. 2 shows a typical caliche mining scene. The introduction of the Butters filter is regarded by some of the oficinas as a great improvement in effecting higher recovery. The results obtained at the Agua Santa *maquina,* where the process has recently been installed, will determine the value of the filters.

There are about 170 companies operating in the nitrate fields. The tons of nitrate contained in the land owned by the different nationalities is as follows: English companies, 12,500,000; Chilean companies, 9,533,850; German companies, 5,048,750; other nationalities, 4,017,500. Recent purchases probably invalidate these figures, although they remain approximately correct. There is but one American company operating in the region.

Comparing the foregoing with the total reserves already given, it will be seen that the greater part of the nitrate deposits still remain in the possession of the government. At times parcels of land on which the tonnage has been estimated after examination by government engineers and on which a minimum price per quintal has been set are offered for sale to the highest bidder. At the last sale several parcels were offered, the minimum prices being fixed at 4 to 6 pence a quintal, or $1.58 to $2.37 a ton, but only one tract was sold. The sale price must be paid in cash at once, while in addition the government levies 28 pence a quintal, or about $11.20 a ton, export tax on the finished product. Until the outbreak of the European War the bulk of the nitrate went to Germany, and consequently when this market was closed, all but a few of the companies ceased operations. Most of them resumed, however, during 1915. At present the greater part of the nitrates come to the United States.

As a byproduct in the elaboration of the nitrate, considerable iodine is obtained. The annual production is in normal times about 450,000 kg., but since the war has created a greater demand for it in the dressing of wounds, the production has considerably increased. The export tax is $0.46 a kilogram.

### Coal, Borax and Sulphur Industries

Coal was discovered in the vicinity of Concepcion in 1840, and mining operations started there about 1850. The coal is semibituminous in character, but inferior to that imported from England, Australia and North America. The production amounts to somewhat more than 1,000,000 tons a year. It is all used by the local railroads and steamship lines, and at present constitutes about two-fifths of the total amount of coal consumed in the country. The chief mines are at Lota, where brick, pottery and glass factories and a copper smeltery are located on account of the coal supply. The coal that is imported into the country is largely brought by vessels that carry the nitrate to the foreign markets.

In the high Cordillera near the Bolivian border are a number of extensive borax lakes containing sufficient material to supply the world's markets for several centuries. The industry is controlled by the Borax Consolidated Co., Ltd., which is operating at Lake Ascotan with its plant at Cebollar on the line of the Antofagasta-La Paz R.R. In certain places the deposit consists of almost pure

Ulexite, and this material is merely dried preparatory to shipment. The output varies from 30,000 to 50,000 tons a year, on which the government levies an export tax of $2.38 a ton.

In the northern portion of Chile near the Bolivian border there are a great number of recently extinct volcanoes that contain great deposits of native sulphur formed by the sulphurous gases given off through fumarolic vents. These deposits are in every case high up on the mountains or even at the summits, so that the difficulties of working them are very great. Fig. 3 shows a typical sulphur deposit at an altitude of 18,500 ft. above sea level. At present only those deposits near railroads are being worked, the chief activities being centered at Tacora along the Arica-La Paz R.R. and at Ollagüe along the Antofagasta-La Paz R.R. At the former place the sulphur is refined by volatilization, as in that vicinity there is an abundant growth of yareta, a mosslike plant containing much resinous matter. In the vicinity of Ollagüe only the pieces of practically pure sulphur are taken from the mines, the remainder being discarded and the sulphur shipped without any refining. During 1915 several new companies began operation, and the increased production will shortly demand foreign markets as the country only requires a limited amount.

In conclusion a few words should be said in regard to the active mining society of Chile, the Sociedad Nacional de Mineria, which corresponds to our American Institute of Mining Engineers. This organization has accomplished much in making known the mineral resources of the country. It publishes a bimonthly bulletin in addition to statistical volumes of mineral production and maintains in Santago a museum where can be seen specimens from the leading ore districts of the country.

## Mining Progress in California

The mining industry in California in the first half of 1916 compared to the first half of 1915 shows greater activity, due largely to reopening of old properties that have not only added to the production of metals, but have accounted for large amounts of money being spent for installation of machinery. Notable among these old mines that have been reopened are the Dutch-Sweeney-App in Tuolumne County and the Old Eureka in Amador County; the former had been a producer from the operation of the Dutch-Sweeney and added largely to its production by the taking over of the App, which had long been idle. The Rawhide, in Tuolumne County, which had also long been idle, has not yet been made productive, but is being prepared for resumption of productive operation. According to the report of Charles G. Yale, of the United States Geological Survey, aside from the gold, silver, copper and lead mining of the state, there has been in the first half of 1916 a heavy demand for such mineral substances as chrome, tungsten, magnesite, manganese, antimony and lesser minerals. For the first time in the mining history of the state many districts are shipping crude ores to the Eastern seaboard by rail, which has been permissible on account of extraordinarily high prices.

There has been no noticeable increase in the number of productive gold mines, and the local smelters and refiners are shown by the reports of the United States Mint at San Francisco to have received $366,000 less California gold and 22,000 oz. more silver in the first five months of 1916 than in the corresponding period of 1915. This may be due somewhat to the greater activity in other productions than that of gold. The five Mother Lode counties, Mariposa, Tuolumne, Calaveras, Amador and Eldorado, produced 61% of the output of siliceous ores. Deep mining outside of the Mother Lode region has been unusually active, particularly in Nevada County, where the North Star and Empire mines are the leading producers and are finding high-grade ore at depth. A strike of high-grade ore carrying telluride was made in the Champion group, and in this section a number of small mines that have been idle are coming into the possession of the larger companies in order to improve their position in the districts.

In the southern counties, notably Inyo, San Bernardino and Riverside, there is a distinct revival of mining activity and a noticeable improvement in transportation by the adoption of motor trucks and caterpillar tractors. The Cerro Gordo mine, situated east of Owens Lake, has been producing large shipments of zinc and lead ores as well as silver. At Randsburg the Yellow Aster has continued to be a large producer and it as present adding to its metallurgical equipment by the installation of a dry-screening plant with which to eliminate the coarse waste before the material reaches the stamps, doubling the plating area and putting in a Dorr thickener to recover the water.

The high price of tungsten made possible the development of new areas of scheelite at Randsburg and Atolia and the opening up of an entirely new camp at Bishop. While the declining prices of tungsten in the past two months has to some extent curtailed the output, the properties that have an appearance of permanancy are still being worked in the Randsburg and Atolia districts; and the tungsten miners in the Bishop district are going ahead with their mill installations in the belief that the market and price will continue to be equal to the requirements of economically operated mines.

Dredging, which produces 85% of the placer gold in California and 38% of the total gold yield, continues in a flourishing condition. There have been two large gold dredges completed in the Yuba Basin field, one by the Yuba Consolidated Gold Field and one by the Marysville Gold Dredging Co., and other installations are contemplated. There has been a good deal of talk in the past two or three years of decadence in gold dredging in California, due most likely to the fact that some of the fields are being worked out; but new fields are being found. In Trinity County the Guggenheim interests are building a new 9-cu.ft. bucket dredge, and the same interests are building one of the same size on Yuba River, near Smartsville. Another new dredge is being built by the Oro Dredging Co. in Calaveras County.

Hydraulic mining is still active in Trinity and Siskiyou Counties; a merger of hydraulic-mining interests is reported in the Slate Creek district, Sierra County, which contemplates the building of a large restraining dam across Slate Creek, which will permit hydraulic mining at Scales, Port Wine, Whiskey Diggings, Gibsonville, La Porte and other old camps in Sierra and Plumas Counties. Some new mines are reported also in central California.

There has been a revival of drift mining along the Magalia ridge in Butte County and also in Sierra County.

Copper mining has been very active in the first half of the year largely because of the high price of the metal. The larger companies have increased the wages of the miners in the form of a bonus during the period of high prices. New copper properties have been opened in Trinity, Siskiyou, Plumas and Madera Counties and in some counties of the south. The Engel Copper Co. in Plumas has adopted the flotation process of ores shipped to Nevada smelters. The Calaveras Copper Co. has increased the capacity of its flotation plant. The Penn Mining Co. won its first legal battle with the farmers who had brought suit in the United States District Court for alleged damages from sulphur-dioxide fumes.

Altogether the mining industry of the state is advancing, and there is good evidence of the advancement being of permanent character.

## Mine Experiment Stations Named

The first two experiment stations provided for in the act passed by Congress last year, and appropriated for at the present session, will be situated at Fairbanks, Alaska, and at Tucson, Ariz. A third station, the situation of which has not been definitely settled, will probably be placed somewhere in the Pacific Northwest. In addition three mine-safety stations will be established at Butte, Mont., Reno, Nev., and Raton, N. M. The sum of $25,000 has been appropriated for each of the mining experiment stations, and $101,500 for the three safety stations.

The act authorizes the Secretary of the Interior to establish in the several important mining regions of the United States 10 mining experiment stations and seven mine-safety stations in addition to those already established, but provides that not more than three of the experiment stations and the same number of safety stations shall be established in one year. The purpose of all of the stations, according to the law, is to make investigations for the purpose of improving conditions in the mining, quarrying, metallurgical and other mineral industries, safeguarding life among employees, preventing unnecessery waste of resources, and otherwise contributing to the advancement of these industries.

Each of the mine-safety stations is to be equipped with an all-steel mine rescue car which will respond to disaster calls within its prescribed territory. Congress has appropriated $53,000 for the purchase of the three cars and the contracts are about to be let by the Bureau of Mines. These cars will be of special design and will represent the most modern thought in rescue work. They will be manned by expert crews of life savers, who, when they are not employed at a mine disaster, will go to the different mining camps and train the miners in rescue work and first aid to the injured.

"There has been a great deal of rivalry between the various mining sections for the establishment of these first experiment and safety stations," said Secretary Lane, in commenting upon the announced locations. "It has been difficult to make selections—in the future some of the other localities will be given their opportunity."

**Iron Mines of Yangtze, China,** are to be opened and exploited by the Japan-Chinese Industry Co., which has obtained a concession for that purpose.

## Ecuador Develops Oil Industry

The successful exploitation of the Peruvian petroleum deposits has led in recent years to the study of the neighboring deposits of Ecuador. Petroleum is said to exist in marketable quantities in the province of El Oro, near Santa Rosa, not far from the Peruvian deposits. The known deposits where outflows are frequently found are contained in an area said to extend from Puntilla, eastward at least as far as the town of San Vicente. This field is 90 mi. southwest from Guayaquil and 740 mi. from Panama.

A spongy blue shale of unknown thickness constitutes the petroleum-bearing stratum. This covers a known area extending about 6 mi. north and south and about 20 mi. inland. The existence of a small oil fountain, together with considerable gas, is thought to indicate that deep drilling will produce flowing wells. Judging from the depths at which oil is found in the adjacent Lobitos field of Peru, it is thought that oil in commercial quantities will be reached at a depth of about 1,000 ft. Drilling, including casing, costs about $7.50 per ft. to a depth of 1,500 ft., and about $10 per ft. to 2,500 ft. There is an abundance of native labor costing 50 to 75c. per day; the drillers and mechanics must be brought from the exterior, with wages from $100 to $150 a month.

The present local demand for about 25,000 bbl. of petroleum for fuel is satisfied by digging holes 10x10 ft. square to a depth not exceeding 50 ft., in which the oil collects by seepage. The demand is increasing considerably, however, and a number of industries in Ecuador would use oil for fuel if the supply were sufficient and steady. The present price is $12 per ton at Guayaquil.

Recently a law was promulgated exempting from all fiscal and municipal duties and taxes the production and exportation of petroleum and its derivatives for a period of 20 years.

The Ecuadorean oil-bearing properties are owned and controlled by local syndicates, but the proprietors are endeavoring to interest American capitalists in the development of the industry, with prospects of ultimate success.—*U. S. Commerce Reports,* July 15, 1916.

## Manganese in the East

The demand for manganese ores and the high prevailing prices lend interest to a report on some manganese mines in Virginia and Maryland, by D. F. Hewett, of the United States Geological Survey. The demand for large amounts of manganese ores in this country began in the period 1865-1870, with the introduction of the Bessemer and openhearth processes of steel making, and has grown enormously. The domestic supplies have supplied only a small fraction of the manganese required by our industries—in 1915 only about 3% and from 1910 to 1914 only 1%.

Virginia has contributed more heavily than any other state to the domestic production. Five of the six deposits described are on the east side of the valley that lies west of the Blue Ridge. They coincide roughly in position with the outcroppings of a group of Cambrian shales and quartzites. The other deposit lies well east of the Blue Ridge. Psilomelane is the commonest manganese mineral of all the ores, but manganite and wad are also present.

# Exploitation of Arkansas Zinc

By Lucius L. Wittich*

*SYNOPSIS—Arkansas zinc ores are mainly carbonates occurring in the magnesium dolomite strata of the Yellville formation. The guiding-formation to the miner is the Key sandstone. Numerous new mills have been recently constructed in the district and others are building or planned.*

Zinc- and lead-ore shipments from northern Arkansas mines are aggregating about 80 to 100 carloads a month. About 85% of this is zinc carbonate, 5% sphalerite and 5% lead, chiefly galena. At no time in the history of the Arkansas district has the output been so heavy; at no time has the activity in mill construction been so pronounced. The influx of miners to Arkansas fields is due to the high price of zinc ore, and the steady demand for it is resulting in the springing up of new mining camps at several points, while old camps are becoming greatly overcrowded.

The chief zinc- and lead-producing counties of northern Arkansas are Boone, Marion, Baxter and Searcy. Railroad shipping points are situated along the White River division of the Iron Mountain R.R., which runs through the western part of the district, and along the Missouri and North Arkansas R.R., which traverses the eastern part of the district. As many of the heaviest producing camps, such as Rush, Maumee and others, are far removed from railroad points, long hauls over the mountainous roads are necessary. The average cost of getting concentrates hauled to the railroad is from $1.50 to $3 a ton, native labor being exceptionally cheap in this respect. The transportation facilities at Rush, the largest producing camp, will soon be greatly improved through the completed construction of a narrow-gage railroad from Yellville Junction, 14 mi. distant. Owing to the isolated situation of many of the mills, it is too expensive to haul coal for fuel, and wood is the most common fuel. Oil engines are beginning to be used also.

Unlike the deposits of the Joplin district, which are found in the Mississippian series of the Carboniferous system, the Arkansas ores occur chiefly in the Yellville formation of the Ordovician system, which is a much older sedimentation than the Mississippian. The Yellville formation is composed of magnesian dolomites, outcropping being common in northern Arkansas. The base of this rock system shows no outcropping, and its depth is estimated only by deep drilling, which indicates that it may extend down to the pre-Cambrian crystallines. Where the Yellville formation outcrops along the White River, its width reaches 500 ft.

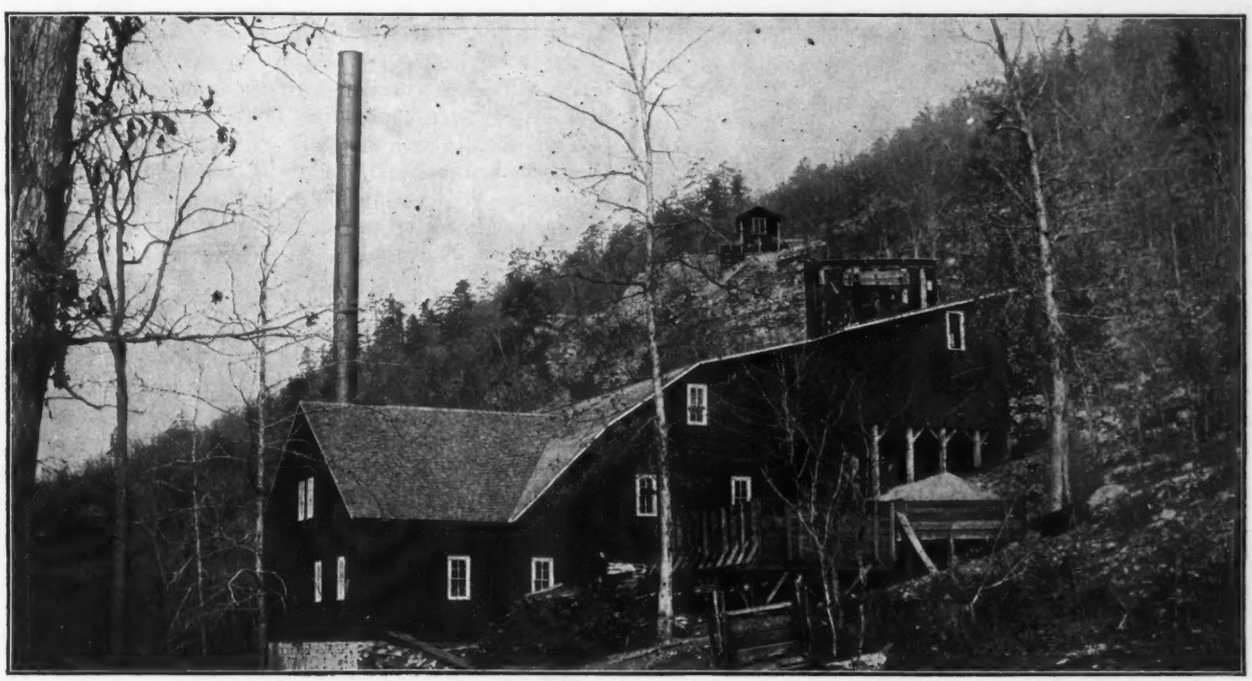


FIG. 1. McINTOSH ZINC CONCENTRATOR, RUSH, ARK.

Just as the oölitic limestone is the guiding geological formation of the Joplin district, overlying the Grand Falls chert or ore-bearing stratum of the sheet-ground regions, so in the northern Arkansas field the most valuable guide is the Key sandstone, which occurs in benching and usually marks the cap rock, overlying the dolomites in which the ore occurs. The Key sandstone is distinguished through its resemblance to coarse brown sugar and its decomposed appearance. Fracturing, jointing, faulting and slight brecciation characterize the areas where the mineral is most likely to be found. The ore, when a blende, usually produces a concentrate running as high as 62 to 64% metallic zinc, with no iron, while the carbonates produce a concentrate, or free chunk ore, running from 38 to 48% metallic zinc.

*Recently deceased.

The first mining in the district was for lead in 1818, but not until 1857 was lead produced on an extensive scale. In the same year zinc carbonate was produced for the first time. In 1899 prices soared to a point that encouraged extensive mill construction. The greatest activity, however, began about six months ago, since which time about 20 new mills, chiefly of the most modern design, have been constructed, and 12 or 15 more are either in course of erection or will be built in the near future.

As the ore-bearing stratum usually is found outcropping high on the mountainsides, the method of mining in most instances is confined to drifting in on the orebody. Sometimes the ore formation is simply quarried, and where the ore is rich enough, mill concentration is sometimes dispensed with and the free carbonate (little blende is mined in this manner) is corded up and sold to the smelter. The ore is sold chiefly in the open market to the highest bidder, although where some producers have made long-time contracts with smelting concerns, the former are getting all the best of it, owing to the fact that the open-market prices have declined materially. The ore goes to smelteries in Illinois, Kansas and Oklahoma and is reputed to make an exceptionally choice grade of spelter, due to the almost complete absence of lead and to the high grade of ore.

### Treating the Sludge Ore

A feature of concentration that has been overlooked by almost every operator in the district is the importance of treating the sludge ore. Believing that the carbonate ore did not possess enough specific gravity to respond to table concentration, producers were formerly wont to discard all the tailings without even so much as passing them through a settling tank, and without giving them a single table treatment. Recently, however, where experiments have been conducted, it has been proved that the percentage of loss can be cut down materially, as a result of which more tables are finding their way into Arkansas mills. The average Arkansas producer is inclined to consider it a boon to be enabled to discard his tailings directly into the creek or river that flows through the valley, on the precipitous side of which his mill is usually situated. Many of the district's largest plants are along Rush Creek and Buffalo River, and there is no doubt that hundreds of thousands of dollars in metallic zinc have been lost as a result of discarding the refuse from the mills into the streams.

The Big Hurricane No. 2 mill, operated by John Conness Shepherd, of Rush, and situated 4 mi. west of Pindall, Ark., or 40 mi. west of Rush, will soon be one of the most complete plants in the district. Among other machinery items it will have a 6-ft. by 16-in. Hardinge conical mill, the first of the kind to be used either in the Missouri or the Arkansas district. Other features of this new mill will be a Dorr thickener, 30 ft. in diameter by 10 ft. deep, 7 Wilfley tables and 1 Diester-Overstrom slimer. Feed for the mill will be furnished by a 3-in. suction pump. The mill will be run by a Fairbanks-Morse oil engine. Shepherd owns the fee to 588 acres on which the Hurricane is situated, having purchased it recently for $85,000. At the Hurricane No. 1, which is a mere "coffee mill," the output is already 25 to 40 tons of concentrates a week. A carbonate deposit, outcropping on a hillside and mined from an open pit that has reached a depth of 85 ft. and a length of 200 ft., furnishes the ore. The No. 2 mill will be situated across the valley north from No. 1 and will, for the time at least, handle only the tailings from the No. 1 property.

At the Philadelphia mine in Rush, steam power has been replaced with oil engines of the Fairbanks-Morse make, one of 100 hp. having been installed to run the mill machinery and another of similar capacity to operate a 600-ft. Ingersoll-Rand compressor. Sullivan Jackhamers are to be used for the lighter work of running prospect drifts, while the regulation drills will continue in use in the tunnel mining. A new aërial tramway, ¼ mi. in length and spanning a deep ravine, will connect the Monticello shaft on the south side of the valley with the mill. The tramway will be almost 200 ft. in height at its highest place and will be built at a cost of about $8,000. Mining at the Philadelphia, which is one of the steadiest producers in the Rush field, is carried on from three tunnels at various elevations above the bottom of the valley. The highest is about 225 ft. above the creek bed. Beneath this is a tunnel 175 ft. above the creek bed. From both these tunnels run numerous smaller drifts at varying levels, some rising above the floor of the main tunnel and others dropping below it, according to the trend of the orebody, which has made in breaks between limestone walls. The ore from both these tunnels is sent down chutes lined with railroad iron, to the mill hopper. From the third tunnel, which is only 30 ft. above the creek bed, the ore is hauled to the mill and hoisted up to the hopper. In addition to the two Wilfley tables already in use at this property, two additional tables are being installed.

### New Mill Construction in the District

Two large new concentrating plants have just been completed in the south end of the town of New Rush, which is 1¼ mi. down Rush Creek from the old town. These mills are the Edith and the Yellow Rose, the former operated by E. Emanuel and the latter by James McCarty & Co. The Edith gets its ore, a white carbonate, from a tunnel in the mountainside and treats it at a 200-ton plant operated by two 50-hp. Chicago-Pneumatic oil engines. This mine is situated on a lease from the Buffalo Zinc and Copper Co. The Yellow Rose is equipped with Chicago-Pneumatic oil engines and has a daily capacity of 100 tons. The company owns a fee to 4 acres and has first lease on 40 additional acres.

Although the sidehill locations of most of the mills in the district provide conditions ideal for gravity milling, little advantage of their situation has been taken by most Arkansas mines, and the ore handling is much the same as in the average plant where ore is hoisted from a vertical shaft to a mill built on level ground. The one important exception to the rule is the McIntosh mill, shown in Fig. 1, a new plant of 100 tons' daily capacity, situated on an 80-acre lease between the new and the old towns of Rush, and owned by John Conness Shepherd. Steam power, wood being the fuel used, runs the mill. The ore passes from hopper to crusher, thence to rolls and revolving screen, thence through the ordinary process of mill concentration, each step, however, being at a lower level than the preceding one. Only one elevator is used, that being to lift the middlings back to the rolls.

The oldest producer in the Rush field, and one of the best known mines in northern Arkansas, is the Red Cloud,

situated on a 400-acre lease from the Red Cloud Mining Co., on the right-hand bank of Buffalo River, opposite the Edith and the Yellow Rose mines. Recent improvements have been made in the Red Cloud mill, and the property is now producing about a carload of concentrates a week. More than 2,500 ft. of tunneling has been done at this property. Outcropping zinc blende led to the first development, but the blende formation proved only a veneer, beneath which an extensive formation of carbonate was found. The occurrence of the carbonate is in large and small fissures, the larger runs extending almost squarely back into the mountain, while smaller leads are followed at right angles from the main deposit. Occasionally a body of blende is found, but the chief production is of carbonate. R. C. Day, of the Day Rubber Co., St. Louis, is head of the Red Cloud company, which operates in addition to the Red Cloud mine the Buffalo Zinc and Lead Co. property, now constructing a new mill on Rush Creek.

In the vicinity of Zinc, Ark., are found the largest blende-producing mines, and in this field numerous new mills are in course of construction. These mines also produce a heavy tonnage of carbonate. Owing to better railroad facilities, development near Zinc has received quite an impetus of late. One mile east of Zinc is the Rising Sun mine, formerly known as the Jack Pot. Here a 100-ton concentrating plant has been constructed and both blende and carbonate are being turned out. Other new mills near Zinc are the Coker Hollow, owned by Judge J. M. Hayes; the Almy, owned by W. P. Kendall; the Gloria, owned by Col. W. H. Almy.

The Zinc district lies to the north of Rush. To the southwest of Rush is the Maumee district, near which is situated the Sure Pop mine, reputed to have the highest percentage of carbonate recovery of any Arkansas mine. A 50-ton mill produces a carload of carbonate a week, it is reported. The mine is on a lease of 160 acres. The Sure Pop No. 2 is run by F. M. Kennedy, of Maumee, whereas the No. 1 mine is one of J. Conness Shepherd's properties. The No. 2 mine is to be equipped with a 100-ton concentrating plant. In this same region is the Silver Run, located on the Reese land, mining through one shaft and one tunnel and operating a new 100-ton mill which produces both carboate and jack. Among other mines of the vicinity may be mentioned the Jack Pot, where Thomas Neal and associates are reconstructing a mill; the Churchill, equipped with a new 150-ton mill, and the Evening Star, also equipped with a new 100-ton mill, operated by N. W. Redwine, of Leslie, Ark.

## Metallurgical Industries in France in 1915

In the metallurgical industries of France the blast furnaces, rolling mills and other plants were actively employed throughout the year, almost exclusively on government work. As shortly after the outbreak of hostilities the great metallurgical centers of the northern and eastern districts of France were occupied by the enemy and possession taken of the rich ore mines and the important furnaces and rolling mills that are located in that region, a large proportion of the steel and iron supply of France was eliminated, according to the "Commerce Reports" of June 28, 1916, of the U. S. Department of Commerce.

By accelerated operation, by putting furnaces into blast that had been idle and by erecting new furnaces, the normal output in the other metallurgical districts in Normandy, Brittany, Anjou, the Midi, Pyrenees, Nancy, etc., was greatly increased. But the orders placed by the government for guns, projectiles, armor-plating for vessels, structural steel, etc., were so abnormally large that the home supply of raw or half-finished materials was not sufficient, hence great quantities of foreign steel and iron were imported. The receipts of pig iron in 1915 were 166,709 tons, against 15,886 tons in 1914; steel billets and bars, 581,482 tons, against 16,882 tons; machine iron and steel, 64,831 tons, against 5,160 tons; iron and steel rolled plates, 78,628 tons, against 7,763 tons; tin plate, 68,340 tons, against 24,878 tons; iron and steel plain and barbed wire, 46,105 tons, against 7,407 tons; and steel rails, 40,659 tons, against 547 tons.

## John F. Campion

SPECIAL CORRESPONDENCE

By the death of John F. Campion in Denver, July 17, which was briefly noted in the *Journal* last week, Leadville lost one of its most loyal and successful pioneers. Mr. Campion entered the district in the spring of 1879, when Leadville was in the midst of the greatest mining boom in the history of the West. He had previously engaged in several ventures in California and Nevada, meeting with varied success, his most important undertaking being the purchase of the Pioche-Phœnix property at Pioche, Nev. The experience acquired through his activity in California and Nevada equipped him with an invaluable knowledge of practical mining, and upon his arrival in the Leadville district he was fitted far above the average man for taking advantage of the opportunities open to him. He made a careful study of the geology of the district and solved to his own satisfaction many of the intricate problems which confronted the mining men of the early days.

Mr. Campion has often been termed "lucky," but mining to him was more a matter of business than a gamble. He understood the risks and he also fitted himself against these risks by securing a thorough knowledge of a venture before entering upon it. Undoubtedly good fortune followed him in many of his undertakings, but he never ventured blindly.

The first activity undertaken by Mr. Campion in the Leadville district was on the Elk and Lucy B. Hussey properties, in what is now known as the Down Town section. These properties are in a territory that has been broken and displaced by many faults and where an intimate knowledge of the geology is necessary to develop the ground intelligently. Under Campion's trained and efficient management large orebodies were opened in both properties, and he extracted sufficient money from them to enable him to carry on other ventures which ultimately made him a millionaire.

It is stated that at one time in life every man has the "big adventure." In the life of John F. Campion, the big adventure was the Little Jonny Mine on Breece Hill, a property that is world-famous as a producer of gold. Campion always had a consuming faith in Breece Hill, believing that one of the largest mines in the district would be uncovered there. Several attempts had been made to sink what is now known as the Little

Jonny shaft, but the obstacles encountered, water and dolomite sand, forced the men to give up. These failures, however, had no effect on Campion's faith, and he succeeded in interesting a number of well-to-do men, including A. V. Hunter, G. W. Trimble, Charles Cavender and others, in the undertaking, forming with them the Ibex Mining Co. It cost a small fortune to sink the shaft, and at times the outlook was discouraging. Ore was first encountered in April, 1893, and after that there was no doubt of the success of the venture. The Ibex company quickly realized millions on the original investment, and the property has been producing steadily ever since Campion found the ore in 1893. After securing the greater part of his fortune from the fabulous strikes repeatedly made in the Little Jonny, he undertook mining ventures in every corner of Lake County. Many of them proved unsuccessful, while others added to his great wealth.

With a large fortune and a desire for a quiet life, Campion moved to Denver, where he built a magnificent residence and entered into the business and financial circles of the capital. At the time of his death, he was vice-president of the Denver National Bank, director of the Carbonate National Bank of Leadville, general manager of the Ibex Mining Co., president of the Colorado Society of Natural History, a large owner in the Moffat road and in coal lands in Moffat and Routt Counties, and a cattleman. He gave liberally to charity.

John F. Campion was born on Prince Edward Island in 1849. He is survived by his widow and four children.

## Copper-Smelting Conditions in the Pacific Northwest

SEATTLE CORRESPONDENCE

In the last few years, and especially since the Kennecott and other rich Alaska mines have started producing on a large scale, the tonnage of copper produced by Pacific Coast smelteries has increased amazingly. The smeltery at Tacoma, now a subsidiary of the American Smelting and Refining Co., produced both lead and copper up to four or five years ago, at which time its lead plant was torn out and the plant has since been devoted to copper production alone.

A year ago the plant had two blast furnaces and a converter capacity of 6,000 to 7,000 tons of copper per month and an electrolytic refinery with a capacity of something over 2,000 tons a month. During the last year there has been installed a large oil-fired reverberatory furnace, together with a battery of Herreshoff roasters to smelt the fine ores and a largely increased converter capacity in the form of Smith-Pierce converters. A new refinery, with a capacity of over 3,000 tons of copper per month, has been added, a new power plant built and a Cottrell dust-precipitation apparatus installed. A number of incidental improvements have also been made, including a Bleichert tramway for stockpiling excess ore.

In addition to the British Columbia and Alaska ores that have hitherto been the sources of supply, shipments of copper concentrates from Chosen began to be received at the Tacoma smeltery. A considerable tonnage of oxidized ore from South America was also received. The shortage of ocean tonnage and the high freight rates have combined to keep shipments from these sources down, but the reported recent purchase of three freighters, said to be for use in the South America ore trade, would seem to indicate that ores from this source will continue in importance at this plant. The average copper content of the ores received ranges from 15 to 20%, while the high-grade ore received from the Kennecott mine in Alaska averages 70% copper. A 60% matte is produced,

In spite of the smelteries greatly enlarged capacity, ore shipments have increased to a greater extent, so that the smeltery management has had to discourage larger production from existing producers, but still seeking not to discourage small present or prospective shippers. This has been very fully brought out by a recent announcement of the manager, H. Y. Walker, as follows:

We are so flooded with ore from our regular customers that we would prefer not to receive any new shipments for several months. However, we realize that there are some properties, or prospects, that want to open up, that may be able to ship ore in later years, when copper is around 14c., therefore we do not want to do anything to stop the development of legitimate mining enterprises.

In view of the above-outlined conditions, we have worked out the following schedule, which is practically another way of lending money to legitimate mining enterprises. If you wish to ship ore on this schedule we will be glad to take care of you:

Gold—Pay for 95% of the gold at $20 per oz. No pay for gold under 0.03 oz. per ton.

Silver—Pay for 95% of the silver contents at New York quotation. No pay for silver unless 1 oz. per ton or over.

Copper—Pay for 100% of the copper on the wet assay, less a deduction of 1.3 units at the "Engineering and Mining Journal" wirebar price, less a deduction of 3c. per pound.

Treatment Charge—$1.50 per ton flat when copper is 14c. per lb. or less. When copper is over 14c. per lb., our treatment charge is increased ¼c. per lb. for each cent increase in the quotation over 14c. to a maximum of $3 per ton.

Settlement—Preliminary settlement will be made immediately upon the sampling and assaying of the ore, on a basis of 14c. copper, 55c. silver and $1.50 treatment. Final settlement will be made, however, 90 days after date we commence to reclaim the ore. The copper quotation to be used will be the average quotation for the six days published in the "Engineering and Mining Journal" of the calendar week previous to the ninetieth day after reclaiming the ore. Silver quotation will be the New York quotation on date final settlement is due.

To explain this feature will say that any miscellaneous ores that we buy now, outside of our contracts, will have to go on the dump to be reclaimed when business lets up a little or we complete the installation of additional facilities that we are now putting in, and the quotation will be figured from the date we begin to pick up the ore from the dump. The exact date we do not know, but we hope it will be some time this fall when we can commence to pick the ore up.

Zinc—Limit 8%. Thirty cents a unit charged for any excess.

The above schedule applies on any size lot down to five tons. On anything under five tons, we add to the above rate a flat sampling charge of $10 on each lot.

All schedules on ore not under contract for a definite period of time are subject to change without notice. However, should a shipment be en route at a time when we make a change in our schedule, that one shipment will be settled for on the price as herein quoted.

Treatment rates apply on the ore delivered at our plant.

On the above schedule where the word "ton" is used, it is understood to be a ton of 2,000 lb. avoirdupois; where the word "ounce" is used, as referring to gold and silver, it is understood to mean the Troy ounce, and where the word "unit" is used, it is understod to mean a unit of 1%, or 20 lb. avoirdupois.

In case of umpires, the following rule will be observed. The result obtained, by the umpire shall be accepted by both parties, provided it is between the results obtained by both contestants. If the result obtained by the umpire is above or below the results obtained by both contestants, the assay of the contestant nearest the assay of the umpire shall be accepted in settlement, and the party whose results are farthest from the umpire's result shall pay for the cost of the umpire.

# Concrete Water Tunnel Lining at Chicago

*SYNOPSIS—In driving an 8-mi. tunnel for water supply, the top-heading system was found to be most economical. The use of waste rock in the concrete lining reduced hoisting and concreting costs. Total cost per foot was $61.48.*

The Wilson Ave. intake tunnel of the Chicago water-supply will be about 8 mi. long and 12x12 ft. in section, with vertical sides, semicircular roof and invert floor. To keep the entire tunnel in solid rock, it was placed at a depth of 160 ft. Access to the tunnel was through shafts at five points on its alignment. The following description is prepared from a paper read by Henry W. Clausen, Engineer of Water-Works Construction, at a meeting of the Western Society of Engineers, at Chicago. Union labor is employed at the union scale of wages, which is higher than for tunnel work in other parts of the country. The lowest pay is $4.40 per day, for muckers. Drillers and miners get $5, skilled mechanics, $6, with overtime.

### Top Heading Most Economical

In general the top-heading and bench method is the most economical, operated on the two-shift basis. If there is any quantity of water, it can escape freely instead of being blocked by the breakdown shot of the top heading. The second and most important reason is that on the two-shift basis a certain task can be given to the gang, which must be completed before they leave the work. It is the duty of the miners to set up columns, drill and load their holes, and shoot their rounds before going home. Likewise it is the duty of the muckers to muck out all the rock from the previous shift. It is understood that the time of the shift ends whenever these tasks are completed.

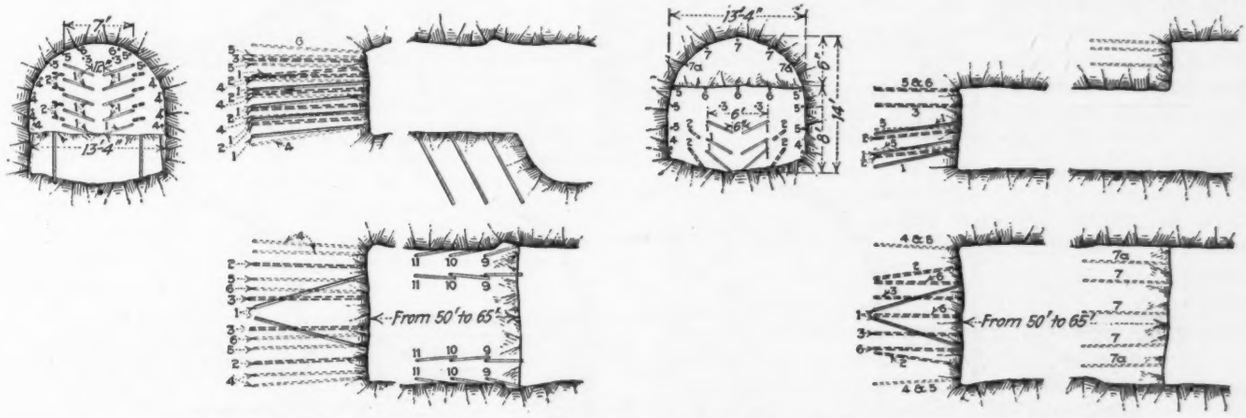
With a well-organized crew, for a 10- to 12-ft. round, the muckers will complete their work in from 6½ to 7 hr. and the miners in from 7 to 7½ hr. If the gang is not up to standard, it may take from 9 to 10 hr., for which they only receive one day's pay. The fact that a shift can be held responsible for a definite amount of work spurs each man to do his part.

*"Engineering News," May 25, 1916.

In the three-shift method, the gang works 8 hr. and quits, the succeeding shift taking up the work where the previous shift left off. If the previous gang neglected its work, it is very much harder to place this responsibility without argument and question. This is of extreme importance when (as in this case) the work is under the civil-service system, because absolute evidence must be forthcoming before a man can be discharged. The total daily progress was no greater by the three-shift method, although a greater number of men were employed.

The concrete for lining is mixed and placed by the MacMichael pneumatic process. The mixing is done in the tunnel itself. The plant includes a conveyor traveler and a concreting traveler, both built of steel (Fig. 5). The former has an inclined track up which the car loaded with rock is hauled by a cable and 10-hp. electric hoist. The car is dumped at a screen plate having 4-in. circular holes, and the rock passing through falls upon a belt conveyor which delivers it directly to the mixer hopper. The conveyor is driven by a 3-hp. motor and runs at about 150 ft. per min.

The concreting traveler carries the pneumatic mixer and two reserve air tanks of 14 cu.ft. capacity; these are to prevent, sudden drops of pressure in the air-supply line due to the large volume of air required for each discharge of the mixer. An 8-in. pipe leads to the forms.




ALTERNATIVE METHODS OF DRIVING THE TUNNEL ON THE TOP HEADING SYSTEM

The plant, comprising the two travelers, is moved 700 ft. every 12 days. As the forms approach the mixer, the 8-in. pipe is shortened until another shifting of the plant becomes necessary.

The method usually employed by contractors in tunnels of this size has been to complete the drift before starting the lining of the tunnel, bringing all material to the surface. After the mining was completed, the excavated rock stored on the surface was crushed and screened and made into concrete, which was brought into the tunnel and placed by hand behind forms of steel or wood. From 30 to 35 ft. per day was lined in this way. When the drift was long, the concrete sometimes had its initial set before arriving at the forms. By a radical departure from this method, the Wilson Ave. tunnel secures a great gain of economy.

It was noticed that the muck or excavated rock contained considerable fine material and would make good concrete. Various compressor foundations and other miscellaneous concrete work on top were built with this material. Test cubes also showed satisfactory strength. It thus developed that the rock could be used for concrete without previous crushing.

Realizing the possibility of saving time and also of saving the expense of hauling back and forth the material required for the lining, as well as the cost of purchasing crushed stone and sand for the concrete, a method was devised for carrying on both mining and lining simultaneously. For this purpose the screening and mixing machine was installed in the tunnel. It handles all the rock coming from the heading and delivers all rock under 4 in. to the pneumatic mixer. The oversize is rejected and loaded by hand into a car.

The pneumatic mixer delivers the concrete through an 8-in. pipe placed behind the steel forms at a distance of as much as 800 ft. The screening machine and the concrete mixer operate on one track and within the clearance of the final tunnel dimensions.

The forms are made of the traveling type. As the mining and lining had to be carried on at the same time, room had to be provided through the forms for transportation of muck to the shaft, with sufficient clearance for the locomotives. These are Blaw forms, constructed of structural shapes and steel plates in 30-ft. sections, and are mounted on roller-bearing wheels running on 70-lb. rails.

By means of this system of working, approximately 60 ft. is lined in two shifts. The net results are that 20 to 22 ft. a day is mined and approximately 60 ft. of tunnel is lined with the excavated material on each working day in each drift.

In advance of the steel forms, concrete guide walls are constructed by hand. Wood forms are used for these,

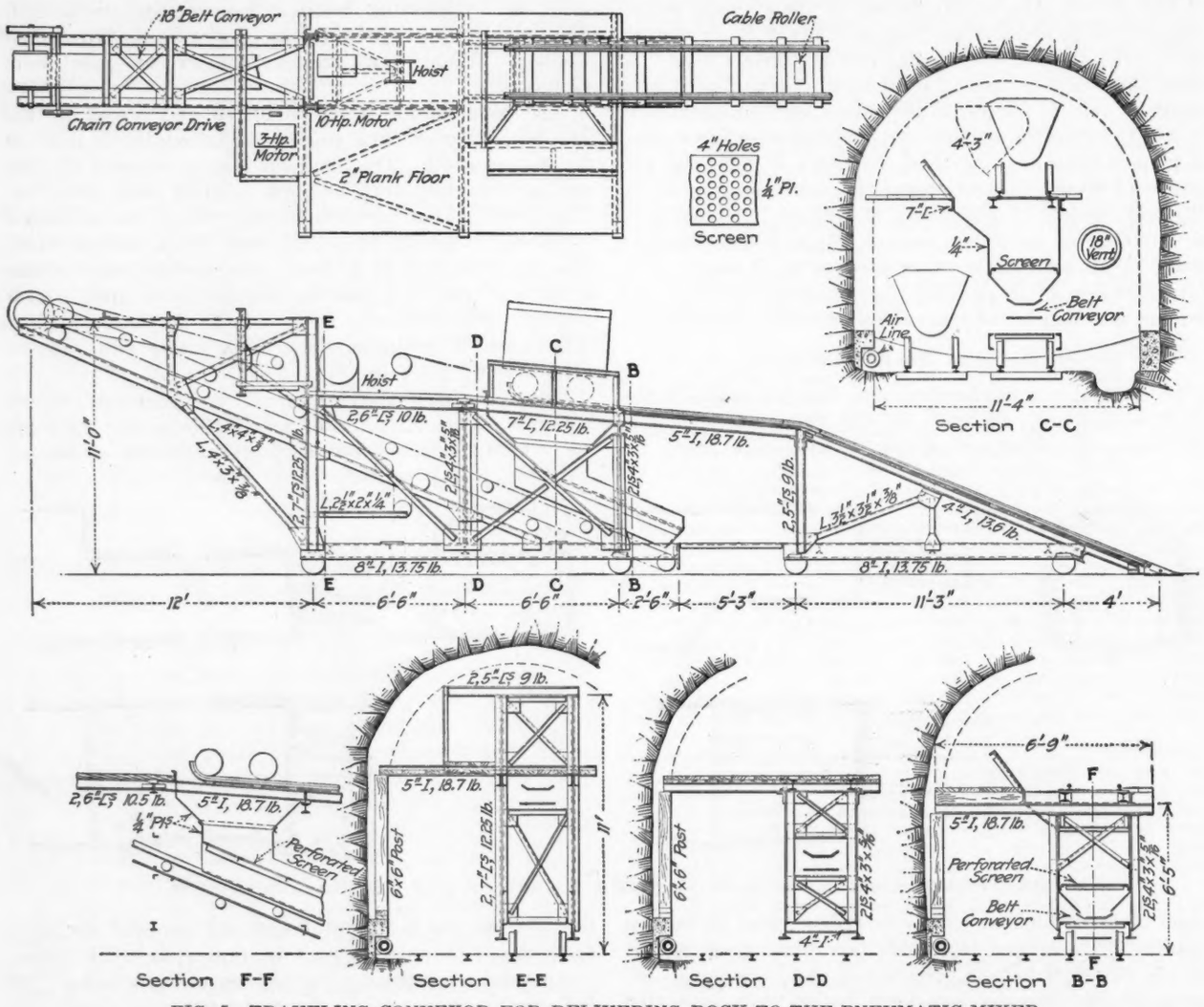



FIG. 5. TRAVELING CONVEYOR FOR DELIVERING ROCK TO THE PNEUMATIC MIXER

set to true line and grade from the engineer's center line and grade plugs. These concrete walls guide the steel forms so that the finished lining is absolutely true to line and grade. Mr. Clausen states that this is something it was difficult to get a contractor to do, his policy being rather to fit the hole as blasted as near as possible and thus avoid trimming. This would sometimes result in the tunnel being a series of short tangents varying 2 to 6 in. from a straight line.

At the Lawndale shaft the rock is of a different texture, 50% breaking over 4-in. size. As at this shaft the total excavation was required for concrete, it was decided to put in a crusher. Accordingly, a concreting machine is

placed in each drift, and the oversize from the east machine (at the face) is put through the crusher and sent to the west machine in the completed drift.

The crusher was mounted on timbering in an enlarged chamber at the bottom of the shaft. Above it and at one side was a track on which rock cars were run from the shaft cage and dumped directly into the crusher. Beneath was another track for cars to receive the rock.

The average daily tunnel excavation is about 20 ft.; on many days as high as 22 and 23 ft. is made. The maximum has been about 26 ft. One reason for the remarkably rapid advance is the rapid clearing of smoke by the ventilation system. On similar work done by contract, the best daily average was 8 ft. A record progress of 15 ft. on one contract left so much trimming to be done afterward that the average daily rate was lower.

When excavating rock at 20 ft. per day, a round trip of the cage is made every 56 sec., 7 sec. being used each at top and bottom for loading a car. The descent would be made in 10 sec. At the bottom of the Lincoln Ave. shaft, in order to facilitate this operation, there is a spare track on one side of the cage to handle empties.

The cost of excavation of 12-ft. tunnel (labor and material) averages $32.94 per ft. The lining was estimated at $15, but is costing less. For all work in 1915, including depreciation of plant, engineering, inspection, excavation, lining and cleaning, the average cost was $61.48 per ft. The cost by contract was estimated at $75 per ft., and on the basis of the lowest bid it would have been $68.20.

## Gold Production in Australia

The gold production of the Australian continent which has been declining for several years, again showed a loss in the first half of 1916. The decrease, as compared with last year was 15.4%, a heavier ratio than for several years, the causes being briefly indicated below. As these causes are still in operation, it is hardly to be expected that the second half of the year will show much improvement.

The gold production of Australia for the half year is reported as follows, comparisons being made with the first half of 1915; the figures are in five ounces:

| | 1915 | 1916 | Changes | |
|---|---|---|---|---|
| Western Australia ..... | 626,930 | 525,035 | D. | 101,895 |
| Victoria ..... | 164,101 | 135,000 | D. | 29,101 |
| Queensland ..... | 128,635 | 116,893 | D. | 11,742 |
| New South Wales..... | 71,942 | 61,000 | D. | 10,942 |
| South Australia ..... | 2,800 | 2,975 | I. | 175 |
| Tasmania ..... | 9,500 | 8,750 | D. | 750 |
| Northern Territory ..... | 1,275 | 1,075 | D. | 200 |
| Total, ounces ..... | 1,005,183 | 850,728 | D. | 154,455 |
| Total, value ..... | $20,777,133 | $17,584,548 | D. | $3,192,585 |

The production of South Australia and the Northern Territory is partly estimated.

The larger mines of Western Australia have continued to produce lower grade ores, and no new developments have been made. In the other states the main reason for the decrease this year has been the shortage of mine labor, which is in large part due to the war and the heavy contribution of men which Australia has made. No new mines or districts have been opened this year. In fact prospecting has been at a standstill, with the exception of a little in South Australia.

New Zealand has made no monthly reports this year; but is reported that there has been a considerable decrease in production.

## Bauxite in the Guianas

A report from United States Consul George E. Chamberlin at Georgetown in British Guiana says that activity in exploring for bauxite in British and Dutch Guiana has been marked in the last two years. Bodies of this mineral have been found in both colonies, and the prospects of those engaged in the industry are believed to be highly satisfactory. A syndicate which establishes a working agreement has been formed, from 13,000 to 14,000 acres of land have been purchased, mining rights over 6,000 acres secured, and application made to the government of British Guiana for the lease of three tracts of Crown land of 500 acres each. All these tracts are on or near the Demerara River, in the vicinity of Wismar, Christinburg and Three Friends, from 65 to 80 mi. above Georgetown. Other deposits are known to the local government, and application has been made for particulars as to the location.

Active operations have been commenced in Dutch Guiana, but on account of the fact that the leases for Crown lands required in British Guiana have not yet been approved by the British government, to which they were referred, no active development has been undertaken in this colony.

The extent of the deposits of bauxite in Dutch Guiana is not known, but they are believed to be fully as extensive as those of the British colony. Some of the known deposits are located as follows: At Oncribo, Para Creek, Surinam River; at Rena Reu Creek, Portorico, on the Surinam River; on the Cotteca River; on the Marechals branch of the Surinam River.

American citizens are not prevented by the laws of either colony from acquiring prospecting and mining rights for minerals, but in British Guiana only British subjects can acquire rights for mineral oil.

Mining concessions or leases of Crown lands in British Guiana, for 99 years or under, may be obtained for any area on payment of $10 with the application and an annual rental of 20c. per acre, payable in advance on Apr. 1 of each year. The concessions are suitable in cases where the work to be carried is of a permanent nature and necessitates the expenditure of large capital, as they are not open to automatic revocation for nonpayment of rental nor are they liable to be jumped, as an ordinary claim license is liable every June.

## Employee's Right to Lien Against Mine

By A. L. H. Street*

Like several other states, Oklahoma has a statute giving a lien to miners and other employees engaged in developing mines, for labor performed in and about the mines. The Supreme Court of that state was recently called upon to apply this law in a case where an employee of a zinc-mining company claimed a lien for services as a watchman over an abandoned mine and for collecting accounts due the mining company. (Hunt vs. Stribling, 157 Pacific Reporter, 741.) In denying that there was any right of lien for such services, the court said: "The purpose of the act was to give those who are engaged in the development and opening up of a mine a lien upon the property for their services."

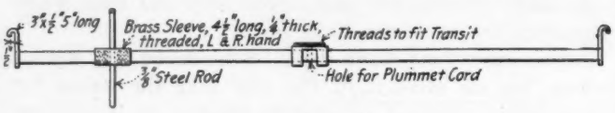
*Attorney at law, 829 Security Building, Minneapolis, Minn.

# Details of Practical Mining

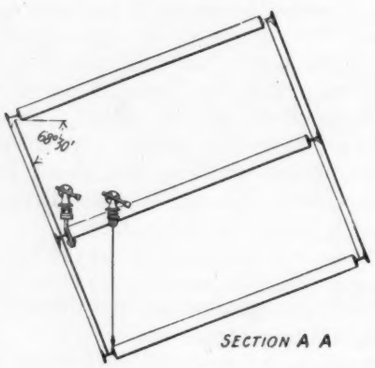
## Supports for Transits

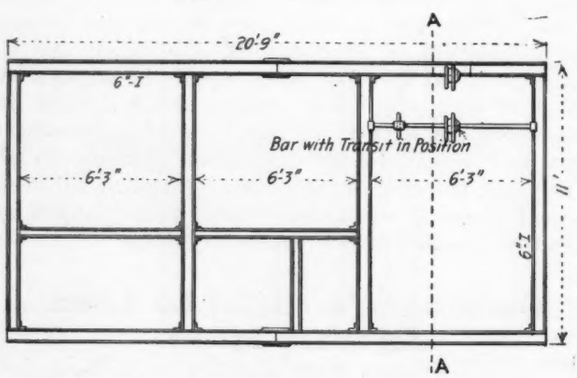
By John F. Spedding*

The accompanying illustrations show two supports used for setting up a transit in a shaft that was being sunk at a steep angle and lined with steel of 6-in. H-section. Before the bar was made, it was decided which would be the most convenient part of the shaft through which to



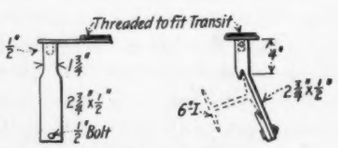

DETAIL OF BAR




SHAFT SET, SHOWING USE OF TRANSIT SUPPORTS

carry the alignment, and then the support for the instrument was designed for such a position on the bar that, when the bar was clamped to the set, the center of the support would be almost on line. In setting up with the bar, the latter is placed on the shaft set and tightened by means of the handle, which turns the threaded brass sleeve, thus forcing the two ends of the bar tight against the end piece and divider.




DETAIL OF CLAMP

The instrument is then screwed on and will require only about ¼ in. of movement to bring it on line, and once set, there is no danger of slip.

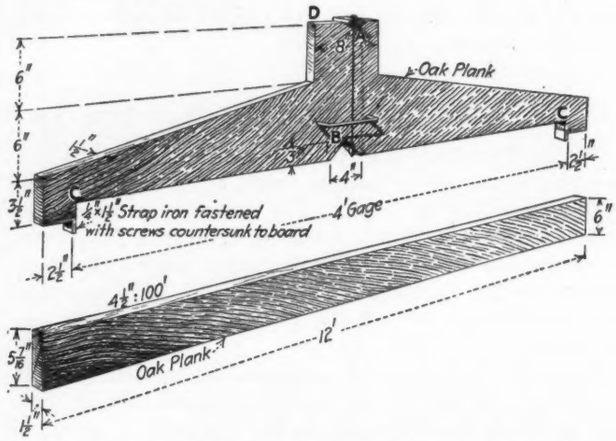
In some cases it was found that it would be much more convenient to have the transit closer to the foot of the shaft, and so the arm was made. This also admits of rapid and accurate setting up, and takes up less room than the bar. About 1,200 ft. of shaft has been lined in with the transit, using either the bar or the arm, and much time has been saved and good results obtained.

*Mining engineer, Box 290, Ely, Minn.

## Gage and Level Boards for Track Laying

There are various devices used by the miner in laying track in the level or drift that he is driving, and those shown in the sketches seem to be as good as any.

The gage board shown in Fig. 1 is used in laying track; and before the second rail is spiked to the ties




FIGS. 1 AND 2. SIMPLE AND PRACTICAL DEVICES FOR LAYING TRACK IN MINES

the miner should try his board on both rails to make sure that the gage just fits over the rails at the offsets *CC*. These offsets are reinforced with strap iron so that constant wear at these points will not alter the gage.

From *A* to *B* a straight line is marked in the exact center of the board and at right angles to the line *CC*. A cord with a plumb-bob attached is suspended at *A* so that the plumb will swing freely in the notch cut at *B*. In turning curves in the mine roads it is desirous to elevate the outside rail, and if the gage board is placed on the rails and a combination spirit level on which can be read the elevation per foot is placed on the plane surface at *D*, the miner can readily raise his rail.

These combination rules and spirit levels are universally used for all kinds of work in and around the mines and can be obtained at almost any hardware store for $2.

The level board used by the miner for carrying his grade is shown in Fig. 2. The large end of the board is placed on the track with the small end pointing in

the direction of the grade. The road is then raised or lowered until the bubble in the spirit level, on top of the board, comes to rest in the center of the rule.

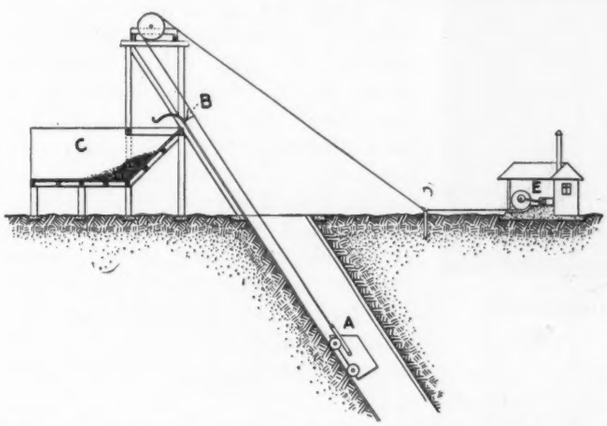
It is extremely important that the miner should carry a good road, for many transportation delays, such as a wet road caused by poor drainage, and much expense and labor are avoided by it. If the miner uses these devices intelligently and his work is checked up occasionally by the mine foreman or his assistant there is no reason why he cannot lay track as well as the tracklayer. —*Coal Age,* Aug. 5 1916.

## Headframe for Inclined Shaft

By Frederick W. Foote

A mine recently reopened in Virginia was entered by an old inclined shaft dipping at an angle of 55°. It was decided to put the hoisting plant on the hanging-wall side of the shaft rather than in the usual position on the foot wall. This was deemed necessary on account of the situation of the mill and waste pile.

A headframe was built of native timber, as shown in the accompanying illustration. Its diagonal legs rested on the shaft collar set, which was a monolithic concrete




HEADFRAME WITH HOIST ON OPPOSITE SIDE OF SHAFT

block, while the posts were set on concrete piers set in the foot wall. The legs were given the same slope as the shaft and carried the track. The skip *A*, which was a wooden affair built on the property, ran up to the point *B*, where it dumped into an ore bin *C*, which was made an integral part of the headframe. An idler *D* kept the hoisting cable down so that it entered the drum of the hoisting engine *E* horizontally. The headframe was successful in operation.

## Development Work Data

Some ideas on the relative advantages of development work by company forces and by contract may be derived from the following data. During a month's operations 568 ft. of development work was accomplished, consisting of raises, crosscuts and drifts. The total actual cost of labor, explosives and timber was $3,959.90, or $6.94 per ft. Some of this work was done on force account and some on contracts ranging from $7.50 to $9 per ft.

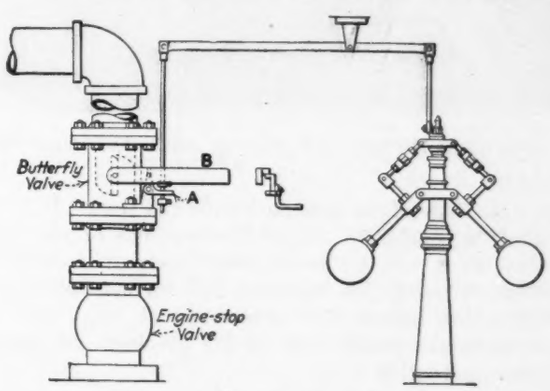
The following instance shows the contractor's gain on a raise 32 ft. high: The price on this was $9 per ft. The contractors received $288, paid out $50 for supplies and did 310 hr. work. Their profits were at the rate of $0.76 per hr., while the current wage scale was $0.45 per hr. This is a gain of 68%. In another case of crosscutting 45 ft. was acomplished under contract at $7.50 per ft., or a total of $337.50. Supplies cost $86.95 for this period. Profits were $250.55 and 726 hr. labor was performed. This compensation was at the rate of $0.34 per hr., or a loss of 24% to the contractors.

The monthly results were as follows: On 568 ft. of development the contractors received $4,279.50 for 528 ft., while 40 ft. was done on the force account. The total supplies cost $1,459.20, so that the contractors received $2,820.30 clear for 5,550 hr. work. This is at the rate of $0.50 per hr., or an average increase of 11%. Expressed in a different manner, contractors made as high as 68% increase and lost as much as 24% and averaged 11% gain over daily wages. The company paid 11% more than if the work had been done entirely on the force account, but doubtless saved more than this in fixed charges, air, superintendence, etc.

## A Home-Made Engine Stop

A home-made engine stop made entirely from material from the scrap heap—except the butterfly valve—is described in the April *Locomotive,* by J. Simpson.

The device as installed consisted of a butterfly valve placed directly above the engine throttle. The disk of the butterfly valve was arranged to be moved by a heavy lever *B* keyed to its stem in such a way that its weight was




A HOME-MADE ENGINE STOP

sufficient to close the valve. The closing lever was supported in a horizontal position, which corresponded to the open position of the valve, by a projection on the side of the lever which caught on the top of a forked bell-crank lever *A*. This little lever *A* was pivoted, as shown, to a small forged bracket fastened to the valve body by one of the flange bolts A rod was attached to the top of the governor and extended upward to connect with the horizontal lever pivoted to a point on the ceiling. The other end of the lever carried a rod which dropped down and hung between the forks of the bell-crank lever *A*. This latter rod was provided with two collars which could be set to trip the bell crank and release the valve-closing lever whenever the governor reached either the top or bottom of its travel. Thus the device would serve to either stop the engine upon the failure of the driving belt so that the governor would stop revolving and fall to the extreme bottom of its travel, or it would also act in the event of

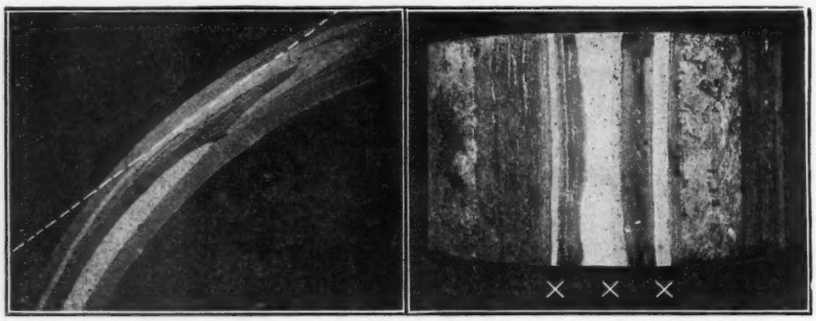
an increase in speed sufficient to send the governor to the extreme top of its range.

The arrangement proved entirely satisfactory and was retained and reinstalled when the engine was erected in a new place.

## Detection of Steel in Wrought-Iron Pipe

An etching test possessing many advantages has been recommended as an aid in detecting the presence of steel in wrought-iron pipe. This test may be used in discovering steel in any of the commercial shapes of wrought iron. The detection of steel by means of picric-acid etching and a microscopic examination requires the preparation of a metallographic specimen and is a tedious operation involving considerable time and great care. Even when the wrought iron contains a large percentage of steel, the steel contents will often be missed, as there is nothing to indicate where the metallographic specimen should be prepared for microscopic examination.

The etching test has been recommended because it eliminates this uncertainty and insures success in discovering any steel that might be mixed with the iron. It is not in itself a conclusive test of the presence of steel, but it does show up the areas most likely to contain it, thereby obviating the necessity for further search and enabling the investigator to proceed at once with the more elaborate preparation of the specimen for microscopic examination.



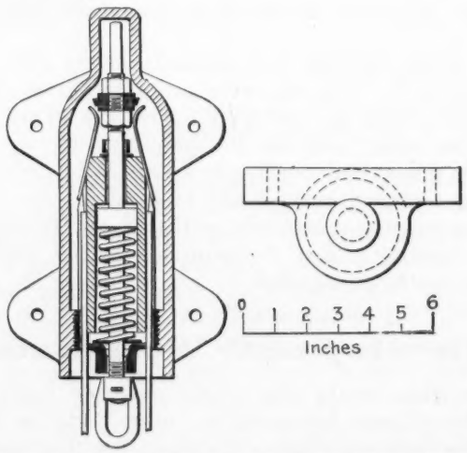
SHOWING METHOD OF FILING PIPE, AND THE BENDS DEVELOPED BY ETCHING

In making the test three or four sample rings 2 or 3 in. long are cut, preferably from different pieces of pipe or from different points on the same length of pipe. The rings are submerged one at a time in a solution consisting (by volume) of 25% c.p. HCl, 1.19 sp. gr.; 25% c.p. $H_2SO_4$, 1.84 sp.gr. and 50% water. After leaving in solution about one minute, the samples are rinsed in cold water and then with alcohol. Both ends of each sample should then be examined to discover bright streaks, which are an indication of steel. An examination of the surface of the metal will not, as a rule, show steel, as steel scrap usually occurs in the middle layers of the fagot. If no suspicious-looking streaks are found in the first ring etched, try additional rings. Three or four rings will usually reveal the steel scrap, especially if rings cut from different pieces of pipe are available.

A flat should now be filed on the outside of the ring suspected of containing steel, as shown by white line on Fig. 1, where the steel, according to the end indications, is most likely to be found. Stop filing when the suspected steel band or bands are half filed away or when their maximum surface is exposed. It is not necessary to polish the surface to be examined. The flat should now be etched, proceeding in the same manner as mentioned for the etching of the ends, keeping the sample in solution one minute or as much longer as is necessary to bring out the steel bands in strongest relief, as shown in Fig. 2. If it is desired to keep the etched surface from fading, it should be covered with white shellac or some other suitable nonacid coating. If any doubt exists as to whether the bright streaks shown on the etched surface are steel, the surface should be polished to the highest possible mirror finish, free from scratches, etched with a 5% solution of picric acid and alcohol, and examined by means of the microscope. The test has been recommended by the A. M. Byers Co.

## Switch for Mine Signal System*

At the Santa Gertrudis mine, Pachuca, Hidalgo, Mexico, signals from cage or skip tender to hoist engineer are by electric bells, the same system being used by persons calling at any level. The bells are the Holtzer Cabot polarized loud-ringing type, 300 ohms resistance, operating on 50- or 60-cycle 110-volt a.c. Current is taken from 1,000-volt power circuit through transformer to 110 volts. The three-wire system is used for the bells of each shaft compartment. Where telephones are also installed, both bell and telephone wires are in one wire-wrapped, lead-covered cable containing several reserve wires for emergency use. No. 18 wires are used. The accompanying illustration shows the waterproof pull switch which is used in signaling and which has given satisfactory service.




WATER-PROOF SWITCH FOR CALL-BELL SYSTEM

One of these is placed at each level and provided with a rope to operate it. This permits its placement out of reach of meddlers.

*Excerpt from article by Hugh Rose in August, 1916, Bulletin, A. I. M. E.

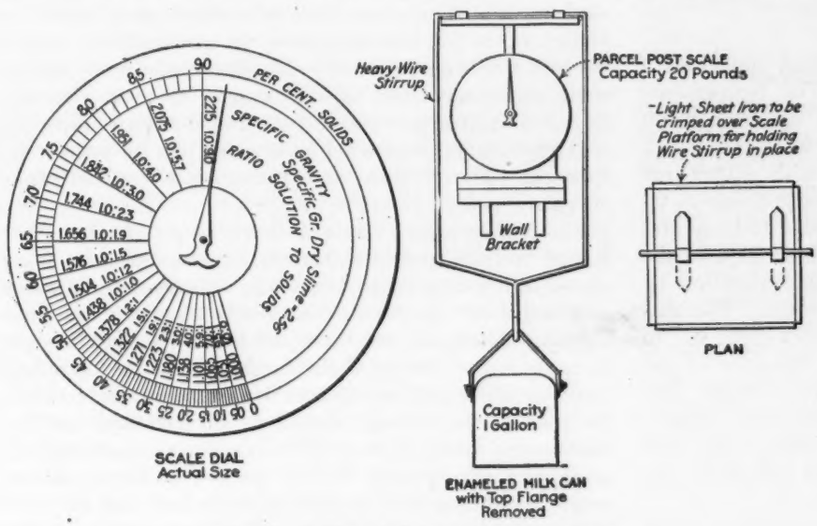
# Details of Milling and Smelting

## Specific Gravity Apparatus

By C. R. Olson*

One having had experience with the specific gravity apparatus in general use about cyanide plants will at once see the advantage of direct readings and the particular kind of apparatus shown in the illustration. The accuracy is well within the limits possible in sampling mill pulps. In this instance a parcel-post scale was used.

I thought it advisable for our purpose to improve on the apparatus described by J. M. Lilligren[1] by having the readings direct in percentage of solids, and in addition to the specific gravity, the ratio of solids to solution are shown also. A piece of drafting paper may be cut




THE SPECIFIC-GRAVITY APPARATUS

to the circle of the dial, graduated and pasted thereon or, better still, a piece of tracing cloth can be cut to the circle of the dial and held there while the points for the graduations are laid off on it. The transparency of the cloth will facilitate the drafting. It can then be removed and the calibrations inked-in over the points. From this blueprints can be made for any number of scales around a plant.

Laying off the graduations for any particular ore, where factors of five in the percentage-of-solids group are desired, may be accomplished either by the aid of a set of specific gravity tables or with the following formula:

$$Per\ cent.\ of\ solids = \frac{S(a-1)100}{a(S-1)}$$

where $S$ = sp. gr. of dry slime and $a$ = sp. gr. of wet pulp, $S$ to be determined beforehand in the usual way. The percentage-of-solids figures are assumed to be 5, 10, 15, 20, . . . 90 and the equation solved for $a$ by substituting the percentage-of-solids in each case and the specific gravity of the dry slime. Having previously decided on the size of sample to be taken in practice, the type and capacity of scale and the kind of container best suited to accurate work, the procedure would be as follows:

Assuming a 1-gal. sample and a scale of 20 lb. capacity and an enameled milk can, the starting point on the dial would be 8 lb. 5 oz. (1 gal. water weighs 8.33 lb. at 60° F.). This point on the dial corresponds to sp. gr. = 1 or 0% solids on the tracing cloth. Substituting 5% and solving for $a$, we get 1.031. Then $1.031 \times 8.33 = 8.58$ lb. = 8 lb. 9 oz., which is the second point on the new dial. Similarly 10% solids is equivalent to sp. gr. 1.065, and $1.065 \times 8.33 = 8.87$ lb. = 8 lb. 14 oz., or the third point on the new dial. After laying off the points on the new dial from 5%, 10%, 15%, . . . 90% and drawing radial lines through them, the intermediate points, as between 0 and 5, 5 and 10, 10 and 15, etc., may be obtained by dividing the respective spaces into 5 equal parts without seriously affecting the accuracy of those points for routine mill work. If it seems desirable that the neck be left on the can and the capacity is greater than one gallon, it is only necessary to adjust the scale to read zero with the empty can suspended from the hook. After filling the can to overflowing with water, the weight may be noted and substituted for 8.33 lb. in the calculations. After the new dial is pasted in place, the can should be filled with water while suspended from the hook and adjustments made on the thumb-nut to bring the pointer over sp. gr. 1 and 0% solids. The scale is then ready for use.

It should be kept in mind that the percentage-of-solids group of figures applies for pulps in which the dry slime is of a fairly constant specific gravity. This, of course, is true for specific-gravity tables as well. Obviously, dry ore-slime from different localities and having different specific gravities would require a calibration in percentage of solids for each particular ore. Whenever a lime coating collects on the can, dilute hydrochloric acid will remove it without injury to the can, providing the enamel has not been cracked. Or the scales can be adjusted by means of the thumb-nut so that the pointer will read 0% solids or sp. gr. 1 when the can is full of water, the reduction in the cubical contents due to the lime coating being negligible when the coating is not abnormal. The cans we buy hold one gallon with the top flange or neck removed which facilitates mill determinations because the can is simply filled to overflowing. Credit is due H. J. Wason, our assayer, for working up data on slimes and providing dials for mill scales.

*Mill superintendent, Pittsburg-Dolores Mining Co., Yerington, Nev.

[1]"Min. and Sci. Press," Feb. 13, 1915.

## The Golden Reward Roaster*

The Golden Reward roaster was built in 1913 to roast the so-called "blue ores" encountered in the mines owned by the Golden Reward in the Bald Mountain district, South Dakota. Previous to this the blue ores were shipped to Denver or Omaha smelteries if they contained value enough to stand the high freight and smelter charges. The blue ores are not amenable to cyanidation in the raw state without preliminary treatment, the extraction of the gold values by cyanidation in the raw state varying from 10 to 30%. Chemical oxidizers or modifications of a straight cyanide treatment do not increase the extraction of the precious metals to make such a treatment commercially successful. The sulphur content of the hard blue ores averages 3% sulphur, while the sulphur in the soft blue or sulphide ore extracted from the Astoria shaft will average 11% sulphur.

Experimental runs of several hundred tons each at different roasting temperatures ranging from 800° F. to 1,600° F. have confirmed the results obtained in laboratory roasts as regards the proper roasting temperature to obtain the highest extraction of the precious metal values most economically. For the soft blue ores this temperature is 800° F. and for the hard blue ores a temperature of 1,100 to 1,200° F. The temperature control in the furnace is maintained by base metal thermocouples and two galvanometers, one of which is a recording instrument. Sweet roasts with either ore prove detrimental to the extraction of the precious metal values and varying percentages of salt added to these ores during roasting causes gold losses as high as 30% of the original value of the ore with a decreased extraction by cyanidation compared to an oxidizing roast. The sulphur content of the roasted product varies from 0.5 to 0.9%, total sulphur, depending on the character of the raw ore and the calcium and magnesium content, the sulphur in the roasted product being present as sulphates or basic sulphates of calcium, magnesium, iron and aluminum. Occasionally sulphides can be detected qualitatively, but not generally.

The roasted hard blue ores can be cyanided direct without preliminary treatment, with a low cyanide consumption and no solution trouble, but the roasted soft blue or sulphide ore must have a water wash previous to cyanidation or a high cyanide and lime consumption, fouled solution, poor precipitation of the dissolved precious metal values and a lowered extraction will result as both the soft blue raw ore and roasted product contain large quantities of cyanicides which can be removed by a water wash. The roasted soft blue ores require but a few hours treatment with cyanide solution to dissolve the contained gold values with a high extraction, but the hard blue ores when roasted require a much longer treatment. A gyratory crusher and two sets of rolls are used to crush the ores, the only change made in the mill between the hard and soft blue ores being in the size of crushing before roasting. The hard blue ores are crushed to pass a Ton Cap screen, having an opening 0.1 in. wide, the screen used giving approximately a six-mesh product, and for the soft blue ores a screen having a square opening of ¼ in. is used. The seven hearth, 22½ ft. in diameter, Wedge mechanical furnace roasts 65 tons of the blue ore per 24 hr., but any increase above this tonnage causes a decreased extraction at the mill and an increased sulphur content in the roasted product.

The feed to the furnace contains 5% moisture and is fed on top of the furnace at the outer circumference. The rabble blades or plows rake the ore across the top of this dryer hearth toward the center shaft, where it drops through drop-holes to the next lower hearth at the inner circumference, is raked across this hearth to the drop holes at the outer circumference and dropped to the next hearth, preceding to each hearth in a similar manner until discharged from the bottom hearth at the outer circumference, taking about 5 hr. to pass through the furnace, the arms of which make 18.6 revolutions per hr. Each hearth has two arms with the exception of the lower or cooling hearth, which has four. The arms are fastened to the central shaft from the inside, making it possible to change arms should it be necessary in a hot furnace. After the arm is in place it can be spotted at one of the doors on the exterior of the furnace and the blade holders slipped over the arm. When a blade holder or blade warps or breaks the furnace is shut down and in a few minutes another blade holder or blade can be put on to replace the old one, and unless the arm needs an entire new dressing the burners seldom need be entirely shut off. The arms are water cooled, each arm having a separate feed and discharge pipe, all feed pipes being connected to a water pan on top of the furnace. The furnace and two coolers require about 90 gal. of water per min.

Six high-pressure crude-oil burners are fired on the second hearth from the bottom of the furnace, being placed equidistant apart around the outside of the furnace and using air at 60 lb. pressure per sq.in. to atomize the oil. The gases are taken off the top hearth, no gas escaping out of the top of the furnace. The feed arrangement on the dryer hearth makes a gas-tight joint unless the feed to the furnace should be shut off and no feed enters the feed slots. The crude oil consumption averages approximately 11 gal. per ton of hard blue ore roasted, and only half as much with the soft blue ore.

The gases leave the furnace at a temperature of 200 to 250° and enter the stack at a temperature of 150 to 200° F. when the depth of the ore bed on the hearths is five inches. The range of temperature from hearth to hearth approaches very closely to the following temperatures: Fire hearth, 1,200° F.; 900° F.; 750° F.; 550° F.; 350° F.; 200° F.; 200° to 250° F. The horsepower demand of the crushing mill and roaster is 135 hp. the roaster, and coolers taking less than 15 hp. Electric motors are used throughout the plant, power being furnished by the Consolidated Light and Power Co.'s plant at Pluma.

The Golden Reward ore is said to be somewhat similar to that formerly mined at the Gold Reef, Fergus County, Mont., and similarly roasted.

*Excerpt from an article by C. G. Willard in the South Dakota School of Mines Publication, June, 1916.

**Investigations for the Government Nitrate Plant** provided for by the Army Appropriation Bill are being made by Colonel Newcomer and Major Kelly, of the Corps of Engineers, so far as all questions regarding the proposed site of the plant and its construction are concerned. A committee representing the Nashville Section of the Engineering Association of the South is to urge the selection of the Muscle Shoals site on the Tennessee River. John Howe Peyton, President of the Nashville, Chattanooga & St. Louis R.R., is chairman of the Committee and Prof. W. G. Waldo, of Vanderbilt University, is the Secretary.

# The Assayer and Chemist

## Determination of Copper in Low-Grade Ores

By F. O. Hawley*

It is generally conceded that the determination of the copper content of ores containing only moderate amounts of iron and practically no bismuth, antimony, arsenic, molybdenum, selenium or tellurium can be most accurately and satisfactorily obtained by the electrolytic method. Unfortunately the chemist often has to assay more difficult ores, some of which have a low copper and high iron content together with more or less of the impurities mentioned. The quick and accurate determination of copper in them presents many difficulties.

The ordinary electrolytic separation in an acid solution is very unsatisfactory in the presence of any metal of the copper or antimony group. The use of rotating anodes gives the deposited copper a better appearance than when stationary ones are used, but the results are little if any more accurate. If the current is too strong or used too long, the results are not so good as with the stationary electrodes. When small amounts of bismuth, antimony and arsenic precipitate with the copper on stationary electrodes, the deposit has a darkened appearance that would never be mistaken for pure copper; on the other hand, when the same amount precipitates with rotating electrodes, the deposit has a much better appearance, except that it has a lighter color than it should have and looks as if it had been dusted with a thin coating of flour.

The colorimetric and cyanide methods are quick, but the results are usually far from satisfactory. Accurate results may be obtained by first separating the copper from the iron and other metals and then determining the amount by the electrolytic, iodide or other standard method, but it is a long and troublesome process, especially with slags, if the gelatinous silica is first dehydrated.

The writer has evolved a method which he recommends to anyone having the necessary apparatus and which is particularly adapted to slags. It is rapid, simple, requires little attention on the part of the chemist and, when properly performed, is very accurate. Antimony, arsenic, bismuth, molybdenum and tellurium, even when present in considerable amounts, have no injurious effect on the assay; large amounts of iron may be present without causing any of the ill effects so often noticed with the ordinary electrolytic determination.

The procedure for slag analysis is as follows: Weigh one gram of the sample into a 200-c.c. tall beaker, add a few drops of water, shake around and add 5 c.c. of an acid mixture made of equal parts of nitric acid, sulphuric acid and water. Shake again and quickly add 20-25 drops of hydrofluoric acid to volatilize most of the silica, put on the hot plate and boil until the red fumes have disappeared; continue boiling about a minute longer to expel most of the silicon fluoride. Add 10 c.c. more of the acid mixture and heat a little longer, remove from the hot plate and add about 70 c.c. of water. Neutralize with ammonia and add 10 c.c. excess. Heat from 60-65° C. (about 150° F.) and add slowly and with constant stirring enough potassium cyanide to combine with most of the copper present. To obtain good results, at least 75% or more of the copper should be combined with cyanide, but an excess is not desirable.

Electrolyze the alkaline solution for about 10 min. with a current of 0.25 amp., using rotating anodes, then increase the current to 0.5 amp. and run for 40 min. longer. Turn off the current and as quickly as possible remove the beaker containing the alkaline solution. Without removing the electrodes rinse off the small amount of solution adhering to them, into a beaker of water. Replace this with a 150 c.c. tall beaker containing cool or slightly warm water acidified with about 7 c.c. of the acid mixture mentioned before. Reverse the current and as soon as the copper is dissolved, which only takes about a minute, change the current again and redeposit the copper from the acid solution, using a current of 0.6-1 amp. This second precipitation takes about 30-40 min., but may be hastened by using a stronger current. The cathodes are removed from the solution, rinsed with water, then with alcohol, ignited and weighed.

In the application of this method to ores instead of slag, some slight modifications are made. The ore is decomposed by nitric acid and potassium chlorate, using hydrochloric also if necessary, and then 8 c.c. sulphuric acid added and evaporated to dense fumes. Three cubic centimeters of nitric acid and about 100 c.c. of water are added, then ammonia and cyanide as before. A little more time may be required for the electrolysis, depending on the amount of copper present. A 1-gram sample of 8% ore requires about 1½ hr. for complete precipitation from the alkaline solution and about 45 min. for precipitation from the acid solution.

The reason for rinsing the alkaline solution from the electrodes before beginning the acid electrolysis is to remove all trace of cyanide, for it is found that a very small amount in an acid solution has a tendency to cause a mossy deposit similar to that formed when chlorides are present. In the case of low-grade slags to which little cyanide has been added, the rinsing may not be necessary.

The precipitate from an alkaline solution of an ore containing much copper has a tendency to be deposited in a somewhat spongy condition. Unless considerable care is taken, there is some possibility of a mechanical loss. For this reason and also because of the increased length of time necessary to precipitate, dissolve and reprecipitate the larger amount of copper, it is generally not advisable to use this method on ores higher than 8%, although by having the proper conditions higher ores may be run.

The copper deposits much better and faster if the alkaline solution is warm. Usually, the heat generated by the reaction between the acids and ammonia is sufficient to heat the solution to about the right temperature. On the other hand, the acid solution may be cool, although the deposition is a little better and faster if it is slightly

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warm. The same solution may be used for three or four determinations until most of the nitric acid is decomposed by electrolysis. There is some advantage in having the beaker containing the alkaline solution covered with a split watch-glass or some similar contrivance, not so much to prevent a loss of copper as to prevent the solution cooling by evaporation.

The quantity of acid used in dissolving the sample is purposely made rather large in order to provide a large amount of ammonium salts, which have a beneficial influence on the deposition. Much free ammonia is to be avoided as it has a tendency to cause the deposit to be granular. On adding the potassium cyanide, care should be taken not to add much more than the required amount, as an excess delays the precipitation. Some of the excess cyanide also will combine with the iron hydroxide, forming ferrocyanide, which is objectionable. A convenient method of adding the cyanide is to take a burrettefull of the ordinary solution used for titrating copper and let it run in slowly, with constant stirring, until the solution is almost colorless. For slags it is generally satisfactory to add the amount thought necessary without trying to see when the exact end point has been reached.

### Copper in the Precipitate

One of the first thoughts that suggest themselves in connection with the alkaline precipitation is whether the iron and aluminum hydroxides do not retain copper and prevent its being precipitated on the cathode. It can be stated positively that when cyanide is used, practically no copper is precipitated with the hydroxides, and even when no cyanide is used, it is found that as the copper is withdrawn from the solution by being precipitated on the platinum, the equilibrium is disturbed and the copper held by the hydroxides goes into solution and soon all is precipitated on the cathode. This is well illustrated by the following experiment: A 1-gram sample of slag, high in iron and containing 0.70% Cu, was dissolved in the usual manner and an excess of ammonia added, but no cyanide. The sample was filtered and well washed with hot water. The filtrate was electrolyzed, and 0.61% Cu was obtained. After the copper had been removed from the solution, the precipitated iron hydroxide was added to the same alkaline solution and again electrolyzed, this time with a new cathode. An additional 0.09% Cu was recovered making the total 0.70% as before. This experiment was repeated several times with similar results, showing the safety of the procedure.

Copper deposited from an alkaline solution is seldom in a suitable condition for weighing, although the appearance is fairly good. It is free from Sb, As, Bi, Te and Mo, but when the sample contains zinc, a little of that metal is usually precipitated. In fact, under some conditions enough zinc precipitates with the copper to form a beautiful yellow brass. A high current density, little free ammonia and a fairly cool solution favor the precipitation of zinc. Of course any zinc precipitated from the alkaline solution will not affect the final result, as it all remains in solution during the acid electrolysis. Indeed, for ores containing over 2-3% Cu, there is some advantage in having the copper precipitated as brass, as the deposit is denser and smoother than when copper alone comes down. A small amount of zinc may be conveniently added with the cyanide, a good proportion being 1 part of zinc oxide to 6 parts of cyanide.

Many experiments were made to test the accuracy of the method in the presence of some of the metals that have injurious effects on the ordinary electrolytic method. Inasmuch as most of the results were similar, only two typical groups of experiments will be given here. These were made on a reverberatory slag and a low-grade ore containing about 60% pyrite. Both ore and slag were practically free from interfering elements.

The following table shows the accuracy of the method for ore and slag in the presence of impurities:

| Sample | % Cu Content |
|---|---|
| 1 gram slag | 0.66, 0.66, 0.64 |
| 1 gram slag + 10 milligrams Sb | 0.64, 0.65 |
| 1 gram slag + 50 milligrams Sb | 0.65 |
| 1 gram slag + 50 milligrams As | 0.66, 0.63 |
| 1 gram slag + 20 milligrams Bi | 0.65, 0.64, 0.64 |
| 1 gram slag + 50 milligrams $MoO_3$ | 0.65, 0.66 |
| 1 gram ore | 2.06, 2.06, 2.05 |
| 1 gram ore + 10 milligrams Sb | 2.06, 2.06 |
| 1 gram ore + 50 milligrams Sb | 2.05, 2.04 |
| 1 gram ore + 50 milligrams As | 2.04, 2.03 |
| 1 gram ore + 50 milligrams Bi | 2.05, 2.06 |
| 1 gram ore + 50 milligrams $MoO_3$ | 2.06, 2.06 |
| 1 gram ore + 10 milligrams Se | 2.09, 2.09 |
| 1 gram ore + 10 milligrams Te | 2.06, 2.07 |
| 1 gram ore (by iodide method) | 2.04, 2.04, 2.07 |
| 1 gram ore (by permanganate method) | 2.06, 2.08 |

Of all the metals added, it will be seen that selenium alone interfered, and that to only a slight extent. Selenium and tellurium, when electrolyzed in either an acid or alkaline solution with pure copper, are precipitated with it, and probably the only reason they do not precipitate in this case is that they are combined with the precipitated ferric hydroxide and so are removed from the influence of the electric current.

A great many tests were made to determine what effect, if any, this method would have on the platinum electrodes. These tests show that with the temperature and amount of current recommended the electrodes lose weight a very little faster than they do in ordinary acid electrolysis. Of course this is a disadvantage, but as the loss is only about 0.0001 gram in four to six determinations it is a very slight one. With higher current densities or warmer solutions the loss may be slightly higher but is never excessive. Some attempts were made to use this method with stationary electrodes, but the precipitated hydroxides hindered a free circulation of the liquid and the results were not very satisfactory.

I think that anyone who gives this method a fair trial and follows directions closely will have no difficulty in getting very good results on any slags or low-grade ores, no matter how impure they may be.

## Chlorate Explosions in the Laboratory

An explosion of potassium chlorate was recently traced by Floyd E. Rowland, of the University of Illinois, to the use of sulphur for sealing in wooden handles to porcelain pestles (*Journ. Ind. Eng. Chem.*, June, 1916). A little of the chlorate worked in between the wood and porcelain while grinding chlorate and violently exploded when the pestle was again put into service. The particular pestle was of German make, but whether this is a common method of sealing in that country is not known.

**That Colloidal Platinum Cannot Be Detected** in ores was disproved by J. Loevy, "Chem. Ztg.," p. 287, 1915, who added colloidal gold and platinum to ores and then assayed them, recovering from 98 to 99.6% of the two metals. This seems to dispose of the choicest argument of the "green gold" Adirondack-mine promoters.

# Estimating Metallic Aluminum in Aluminum Dust

By J. E. Clennell*

*SYNOPSIS—Details, in addition to those previously published, about the methods of testing aluminum dust. Possible sources of error are considered and the means of correcting them when necessary.*

In reference to my article on "Estimating Metallic Aluminum in Aluminum Dust," that appeared in the *Journal* of May 6, 1916, I wish to point out certain additional particulars concerning the two methods described. At the same time I desire to correct an error in one of the figures given at the foot of page 813, column 2, where it is stated that 1 c.c. H at standard temperature and pressure = 0.09004 mg. H = 0.8099 mg. Al. Taking 1 c.c. H at standard temperature and pressure as = 0.0896 mg. (the figure usually accepted), it follows that 1 c.c. of H under standard conditions = 0.80296 mg. Al. In our calculations we adopt the figure 0.803 for simplicity, this being as close an approximation as can be obtained in actual work.

## Study of the Gasometric Method

The gasometric method has been made the subject of further study in our laboratory, mainly for the purpose of establishing a standard method of testing that would be applicable to all samples, whether containing coarse particles or not. It was not intended to use the method for ordinary routine work, as it is too complex and the necessary calculations would be an objection. Certain points noted here were overlooked in the original description.

The following factors are involved in all determinations: Temperature of gas measured; pressure of gas measured; tension of aqueous vapor in collected gas; volume of air expelled with the hydrogen; variations in volume of generating and receiving vessels and solubility of gases in water displaced.

The first three factors are allowed for in the formula

$$V_o = \frac{V(B - T)}{\Delta}$$

With regard to the fourth point, the volume of air expelled, it must be noted that even when the same flask and same volume of liquid are used in all tests, the amount of air expelled is not a constant, but a variable depending on the initial temperature and pressure. We determine the original volumes of generating and receiving flasks by filling with water to the mark reached by the stopper in each case and measuring this water in graduated columns or burettes. These vessels record the correct volume only at some definite temperature (in our instrument this is 17.5° C.), and a correction has to be made at all other temperatures, depending on the difference between the coefficients of expansion of glass and water (see table in "Sutton's Volumtric Analysis," 8th ed., p. 26). Table 1 shows the extremes of variation for the measurements involved in our tests.

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At the end of the operation, when water is allowed to flow back into the generating flask a bubble of gas of about 3 c.c. always remains; this must not be ignored, but by transferring receiver and generator to a body of water sufficiently deep, the bubble may easily be passed through

TABLE 1. EXTREMES OF VARIATION IN TESTS

| Temperature, Deg. C. | Air Space in Generating Flask, c.c. | Total Volume of Receiving Flask, c.c. |
|---|---|---|
| 12.0 | 164.9 | 519.2 |
| 17.5 | 165.0 | 519.6 |
| 25.0 | 165.2 | 520.4 |

a funnel to the receiving flask and added to the main volume of gas therein.

We have as yet devised no new means of estimating the error due to solubility of gases in water, but our results clearly indicate that it is trifling in amount and falls far short of the theoretical maximum calculated from data given by T. E. Thorpe ("Manual of Inorganic Chemistry," Vol. I). This authority gives the number of cubic centimeters dissolved by 100 c.c. of water as follows: Oxygen, 3; hydrogen, 1.93; nitrogen, 1.5. If these amounts had been dissolved, our recorded percentage of Al would have been less than the truth by 6 or 7%, but actual tests have in several cases recorded over 99% of Al, showing that the actual error must certainly be less than 1%.

Measurement of the final volume of gas is best made indirectly, by noting the residual volume of water, after equalizing pressure as described in the article of May 6. This water is measured by pouring into a burette and its amount deducted from the corrected volume of water filling the entire receiving flask at the final temperature, up to the mark on neck reached by cork of leading tube.

Possibly the most accurate method would be to add the necessary amount of oxygen and explode the hydrogen in a eudiometer, thus eliminating the correction for air

TABLE 2. POSSIBLE ERRORS IN DETERMINATION

| Condition | Variation in Condition | Variation in Per Cent. Al |
|---|---|---|
| Temperature | ±0.5° C. | ±0.35 |
| Pressure | ±1 m.m. | ±0.20 |
| Final volume | ±1 c.c. | ±0.36 |

in the generating flask, but this might be inconvenient as the volume to be dealt with is rather large. If the amount of hydrogen were much reduced, as by taking less Al dust for the test, the errors of measurement and observation would become too serious.

In our determinations, taking in all cases 200 mg. of Al dust for a test, the possible errors may be stated as in Table 2.

## Gasometric Method with Sodium Hydrate

Since metallic iron dissolves in hydrochloric acid with evolution of hydrogen, it was thought that this source of error could be eliminated by utilizing the reaction,

$$Al + NaOH + H_2O = NaAlO_2 + 3\,H$$

The theoretical amount of hydrogen obtainable by dissolving a given weight of Al is the same as with HCl, but metallic iron is insoluble in caustic soda. Using 50 c.c. of a 2% solution of NaOH for 200 mg. of the dust, the reaction starts almost instantaneously in the cold, and proceeds for some time without artificial heat. A precipitate, apparently consisting of ferric hydroxide, hydrated

silica and perhaps alumina, remains in the generating flask when the latter fills with water and entangles the residual gas in small bubbles, but this can generally be remedied after transfer to the receiver, by corking the latter and agitating briskly.

Contrary to the supposition, the results with NaOH were generally slightly higher than with HCl, as will be seen in Table 3.

TABLE 3. RESULTS OF GASOMETRIC TESTS

| Sample No. | Description | Metallic Aluminum (Mean Result) By HCl Al% | By NaOH Al% |
|---|---|---|---|
| 1 | Pure aluminum granules | 99.6 | 99.6 |
| 2 | Standard bronze powder | 90.4 | 90.3 |
| 3 | High-grade aluminum dust | 91.6 | 92.6 |
| 4 | Low-grade aluminum dust | 76.4 | 77.2 |
| 5 | Medium aluminum dust | 88.5 | 90.7 |

Samples 3, 4 and 5 represent products obtained in Charles Butters & Co.'s Oakland plant.

The volumetric method with ferric sulphate and permanganate described in the previous article remains the only one rapid and simple enough for routine testing. It has been simplified and improved by adopting a standard solution of acid ferric sulphate, consisting of 100 grams pure ferric sulphate to which distilled water is added and then 250 c.c. of concentrated sulphuric acid. This mixture is heated to boiling until the ferric sulphate has completely dissolved, then cooled and finally made up to a liter with distilled water. For each test on 100 mg. of dust, 50 c.c. of this standard solution is used. More uniform results are obtained than when the dry salt is added before acidulating.

I may add that attempts to check the accuracy of the other processes by gravimetric methods were not altogether satisfactory. In the phosphate method a portion always passed through the filter and further boiling of the filtrate was required for its recovery; nevertheless, the final results were generally too high, and the method proved tedious and troublesome.

In the oxide method the final precipitate could not be accurately weighed except in a closed vessel, as it increases in weight rapidly on the balance; it seems to be hygroscopic, perhaps owing to persistent retention of traces of sodium chloride.

## Chronology of Mining for July, 1916

July 1—Time limit for purchase of Tamarack by Calumet & Hecla expired; deal was blocked by litigation.

July 3—Supreme Court of Nevada affirmed decision of lower court in the apex suit in favor of West End company, of Tonopah; suit was brought by the Jim Butler.—Yuba No. 15 dredge at Hammonton, Calif., started digging.

July 6—Earthquake in Sicily did much damage to sulphur mines near Caltanissetta; about 100 miners said to have been buried.

July 7—Bethlehem Steel Corporation officially announced absorption of Pennsylvania Steel and Maryland Steel companies.

July 10—Revenue Bill, containing clause taxing copper companies, passed by the House of Representatives.

July 13—American Zinc, Lead and Smelting Co. declared initial dividend on its preferred stock.

July 14—Mass Consolidated Copper Co. declared initial dividend of $1.

July 15—Calumet & Hecla Mining Co. celebrated its semicentennial.

July 18—Fluorspar mines in Illinois closed on account of strike initiated by Western Federation of Miners.

July 19—Announcement that Hayden, Stone & Co. had acquired a predominant interest in the American Zinc, Lead and Smelting Co.

July 20—Engels Copper Co., of California, paid initial dividend.

July 24—Utah Metal and Tunnel Co. declared initial dividend of 50c.

July 25—United States Steel Corporation reported earnings for second quarter of 1916 to be greater than any similar period; declared extra dividend of 1% on common stock.—Fire at Mammoth copper mine, California, destroyed boarding house, warehouse and aerial tramway terminal.

July 26—First National Copper Co. declared initial dividend of 25c.

## Alvin Robert Kenner

Alvin Robert Kenner was drowned on July 4 while bathing in a small lake in a public park near Nevada City, Calif., to which place he had recently gone to inspect the Big Murchie mine preliminary to its acquisition by his New York company, the Rio Plata Mining Co.

Mr. Kenner was born in 1885, and was graduated from the Colorado School of Mines in 1907, after a preliminary training at the Armour Institute of Technology, Chicago. Later at Chloride, Ariz., he will be remembered by the many friends that he made while superintendent of a mine there.

During the early days of the first Villa revolution in Mexico he was superintendent of a large mine at Parral, in the State of Chihuahua, where he remained until the Mexicans destroyed the railroad over which the mine shipped its ore to the smelter, and the property closed. The management of the Rio Plata silver mine southwest of the City of Chihuahua called Mr. Kenner to that property, and the shipments of silver bullion made under his superintendency are evidences of his ability. Other properties of great value were purchased under the direction of Mr. Kenner in Mexico by his company.

He was a frequent contributor to the *Journal* and by his death the mining fraternity loses one who had a bright future and would have gone far in his chosen profession.

## California Nickel Discovery

In view of the public interest in metals entering into war supplies, a concise report on the discovery of nickel in San Diego County, Calif., published by the United States Geological Survey, is timely. The author of the report is F. C. Calkins, who describes the deposit and makes suggestions for further prospecting.

The nickel deposit is an irregular body in a dark igneous rock (gabbro) and is shown by Mr. Calkins to have an origin similar to that attributed by most geologists to the famous deposits at Sudbury, Ont. The nickel occurs in an iron-nickel sulphide (probably polydymite), and assays of more than 4% of nickel have been obtained. Copper is also present in quantities ranging from a trace to 2.4%, and conditions are favorable for the presence of platinum.

Another report by the same author describes a deposit of molybdenite, also in San Diego County. The molybdenum prospect is located in a dike of fine-grained granite (aplite) containing an average of much less than 1% of the mineral molybdenite (molybdenum sulphide). Only one prospect has been located thus far, but the surrounding country is favorable for the discovery of others.

These reports are published together as Bulletin 640-D, which may be obtained free on application to the Director, United States Geological Survey, Washington, D. C.

## Wood Oils Suitable for Flotation*

In taking up this work, which had for its object the finding of oils best adapted to accomplish certain things, the Forest Products Laboratory of the Department of Agriculture, which is interested in finding uses for by-products from wood distillation, was represented by R. A. Palmer. The Bureau of Mines, which is interested in finding supplies of suitable flotation oils, was represented by O. C. Ralston, and the Department of Metallurgical Research of the University of Utah, which is doing coöperative work with the Bureau of Mines, was represented by G. L. Allen. The testing of flotation oils has occupied a large part of the time of the testing departments of various companies using the flotation process in the treatment of their ores. The great differences in ores and in oils have made such work necessary, as it has not been possible to select the oil best suited for the purpose without trial of many kinds. In fact, individual shipments of flotation oils from the same manufacturer will often differ so radically that the millmen have been forced to test every lot of flotation oil before its use in the mills.

Further, although almost every imaginable product of the distillation of wood, from alcohol to pitch, has been tested in a more or less perfunctory manner by various people, few companies have allowed the results of their tests to be made public. This work was undertaken for the purpose of obtaining reliable data regarding the value as flotation agents of a number of products that are obtained from the distillation of wood by different methods, and incidentally to determine whether some of the products not used at present could be used. It was thought that if such products can be used as flotation agents, then their use would serve to increase the number of oils and other products available for flotation purposes. It was also hoped that it might be possible to discover a substitute for some of the most effective but comparatively high-priced oils which are now used for flotation purposes.

### Three Types of Ores Treated

Three ores were chosen for tests of the series of oil samples herein described. Ore A was from the mine of the Arthur Zinc Mining Co., near Ruby Valley, Nev. It was chosen on account of its simplicity. It consisted mainly of galena, sphalerite and quartz minerals, which were crystallized in such a way that they could be broken away from each other by crushing to the size necessary for flotation. Ground quartz was mixed with it to make it sufficiently low grade. Any marked tendency of one mineral to float in preference to another could be observed with such a "free" ore. Consequently, the value of the oil for differential flotation of mixtures of galena and sphalerite could be observed; also the conditions which allowed the best extraction or the cleanest concentrate of any of these minerals with any given oil.

Ore B was the heavier sulphide ore from Cripple Creek, Colo. This siliceous ore contains some pyrite, some gold and silver as the tellurides, sylvanite and calaverite, and other tellurium minerals. The tests on this ore would allow observations on the flotation of pyrite as well as of the famous Cripple Creek gold telluride minerals. Wherever the pyrite contains gold it would be desirable to float it, while barren pyrite ought to be kept with the gangue. Hence the tests should be carried on with an ore containing both types of minerals, as was done in this case. This sample was furnished by the Golden Cycle Mining and Milling Co.

The ore C was the Utah Copper Co.'s milling ore from the mine at Bingham. A great many copper minerals are present in this ore—chalcopyrite, cupriferous pyrite, etc. The gangue is siliceous, and the ore is well known. It is a hard ore to treat by flotation, and nearly any oil that will treat it is almost sure of success with most other copper ores. One peculiarity of the Utah Copper ore is that it is much easier to float in an alkaline solution.

Each of the ores was tested with three different tests—an acid test, an alkaline test and a test run in neutral water. The water used in all the flotation tests was the Salt Lake City water. It contains a small amount of lime, so that the water used in the "neutral" tests was in fact slightly alkaline. This method of testing was adopted for the reason that it is known that some oils will refuse to work at all in neutral solution, although they do good work in acid solution. Others are more successful in alkaline solutions.

A flotation testing man must be an opportunist and seize on the best conditions for flotation as he is able to see them in his machine when varying the conditions, such as amount of agitation, depth of pulp in machine, amount of oil, amount of acid or alkali, temperature, etc.

A Janney test machine was used for all this work. Our reason for using this machine is that it permits of quick work and is so designed that practically every particle of flotation concentrate and tailing can be recovered and weighed, while many other machines have inaccessible corners where some of the material escapes.

The extractions were calculated by the following well-known formula, which does not require weights of the products involved:

$$Extraction = \frac{100\,(h - t)c}{h(c - t)}$$

where the analyses of the head, or original ore, tailing and concentrate are represented by the letters in the equation. This formula assumed that any middling produced can be separated into concentrate and tailing. Each test was "roughed" and "cleaned." The rough tail was final, but the concentrate was poured back into the machine with more water and a clean concentrate and middling produced.

The oils tested in these experiments were furnished by the Forest Products Laboratory, Madison, Wis. Most of them were either commercial samples or where pro-

*Excerpt from an article by R. C. Palmer, G. L. Allen and O. C. Ralston to be presented at the Arizona meeting September, 1916, of the A. I. M. E., by permission of the director, United States Bureau of Mines.

duced in the laboratory in semi-commercial apparatus under conditions entirely comparable with plant practice.

The following is a somewhat detailed description of the different oils which are most interesting on account of being immediately available at low prices and because they can be used in small amounts with success.

No. 11 was a commercial wood oil produced in the destructive distillation of hardwood, the particular species in this case being maple and birch. The specific gravity of the oil was 0.934 at 21° C. The chemical composition of this oil is unknown, but it is practically a waste product and is burned for fuel in most plants. It is an excellent solvent, and a small amount is sold for that purpose. A cord of hardwood gives on an average about 2 gal. of this oil, and the production in all the hardwood distillation plants is probably close to 2,500,000 gal. annually. It could probably be bought for $0.10 to $0.15 per gal. f.o.b. plant, as this is the price usually paid for it in the crude condition for a solvent.

No. 18 was a crude hardwood tar just as it settled out of the pyroligneous acid. On distillation the sample gave 12% pyroligneous acid, 8% wood oil, 42% wood creosote oil and 38% wood pitch. The specific gravity of the combined wood oil and wood creosote was 1.067 at 21° C. Excluding the wood oil, about 15 gal. of this tar is produced per cord of hardwood, making available per year over 20,000,000 gal. of this crude tar. This tar with the wood oil and pyroligneous acid removed is generally used for fuel at the distillation plant, where it is worth about $0.03 per gal. for this purpose, in comparison with the normal prices for other kinds of fuel. It could probably be bought for $0.05 to $0.06 per gal. f.o.b. plant.

No. 15 was an entirely different tar product produced in the distillation of hardwood. After the pyroligneous acid has been allowed to stand to settle out the oily tar, it contains a tar-like substance dissolved in it which has to be removed before the liquor can be worked up into alcohol and acetic acid. The yield of this "dissolved tar" or "residual tar" or "acid water tar" or "copper still tar," which are the various names given to it in the plants, is from 6 to 8 gal. per cord, making a total production in the United States of about 9,000,000 gal. per year. It is strictly a waste product at present, although worth about $0.025 per gal. as fuel. It could probably be obtained for $0.04 to $0.05 per gal. at the plant.

No. 16 is a 15% water solution of the water-soluble portion of No. 15, just described. The specific gravity of the solution was 1.061 at 21° C. This sample was prepared to determine the value of the water-soluble portion as compared to the whole tar.

The results of the flotation of these three ores with the above set of oil samples are contained in Tables 1 to 3. In Table 1 the analyses of the concentrate and tailing for each test are given. In the other two tables only the analyses of the concentrate samples are given. Accompanying the analyses of the concentrate samples in each case are the percentages of extraction obtained. The test in neutral, acid and alkaline solutions for each oil is given.

It can be seen that many of the oils give fully as satisfactory results as pine oil for practically all the minerals tested. For all-round work, No. 18 seems to have given good extractions of all the metals tested, together with fair grades of concentrate. It will be remembered that this is the crude hardwood tar which has settled out of the pyroligneous acid. It is a pleasant surprise to find that No. 16, the 15% solution of No. 15 in water, is so efficient in comparison with No. 15. Here is something which is really not an oil, because it is completely soluble in water. It is satisfactory for all the minerals except the copper minerals of ore C.

### Preliminary Results Encouraging

The extractions of the gold in the Cripple Creek ore and the grades of concentrate are surprisingly good. Oils 18, 15 and 16 seem to be capable of producing the highest-grade concentrates. By further treatment of the tailing it should be possible to get even higher extractions, although the grade of the total concentrate would be

TABLE I. TESTS ON ORE A IN NEUTRAL, ACID AND ALKALINE SOLUTIONS WITH DIFFERENT OILS

Analysis Head: Tests on Pb, 3.4%; Zn, 4.74%

| Oil No. | Character of Oil | Total Time, Min. | Total Oil, Lb. per Ton | Total Acid, Lb. per Ton | Total Alkali Lb. per Ton | Lead % | Lead % Extraction | Zinc % | Zinc % Extraction |
|---|---|---|---|---|---|---|---|---|---|
| 11 | Hardwood "wood oil" | 17 | 1.11 | .... | ... | 57.2 | 92.6 | 20.4 | 58.2 |
| | | 10 | 0.18 | .... | ... | 0.3 | .... | 2.3 | .... |
| | | 16 | 0.94 | 3.68 | ... | 37.9 | 88.7 | 34.2 | 72.6 |
| | | 15 | 0.17 | 3.68 | ... | 0.4 | .... | 1.4 | .... |
| | | 15 | 1.29 | .... | 4.0 | 48.0 | 97.2 | 32.0 | 64.8 |
| | | 5 | .... | .... | ... | 0.1 | .... | 1.8 | .... |
| 18 | Crude hardwood "settled tar" | 17 | 1.35 | .... | ... | 48.6 | 97.2 | 28.0 | 68.4 |
| | | 3 | .... | .... | ... | 0.1 | .... | 1.7 | .... |
| | | 19 | 1.24 | 3.68 | ... | 37.7 | 98.2 | 33.4 | 76.5 |
| | | 6 | .... | .... | ... | 0.1 | .... | 1.2 | .... |
| | | 20 | 1.70 | .... | 2.0 | 48.7 | 98.0 | 27.9 | 63.4 |
| | | 4 | .... | .... | ... | 0.1 | .... | 1.9 | .... |
| 15 | "Dissolved hardwood tar" | 20 | 1.44 | .... | ... | 59.2 | 79.4 | 16.2 | 30.2 |
| | | 7 | .... | .... | ... | 0.7 | .... | 3.5 | .... |
| | | 15 | 1.44 | 5.52 | ... | 32.8 | 88.7 | 13.0 | 69.8 |
| | | 10 | 0.72 | 3.68 | ... | 0.4 | .... | 1.9 | .... |
| | | 20 | 1.44 | .... | 4.0 | 66.7 | 73.0 | 38.1 | 30.3 |
| | | 8 | .... | .... | ... | 1.0 | .... | 3.4 | .... |
| 16 | Water solution of No. 15 | 13 | 1.80 | .... | ... | 55.1 | 90.2 | 22.0 | 43.7 |
| | | 5 | .... | .... | ... | 0.4 | .... | 2.9 | .... |
| | | 19 | 1.80 | 7.36 | ... | 30.3 | 92.2 | 40.5 | 77.2 |
| | | 4 | .... | .... | ... | 0.3 | .... | 1.2 | .... |
| | | 19 | 1.80 | .... | 4.0 | 53.7 | 77.4 | 23.3 | 44.7 |
| | | 4 | .... | .... | ... | 0.8 | .... | 2.9 | .... |

TABLE 2. TESTS ON ORE B IN NEUTRAL, ACID AND ALKALINE SOLUTIONS WITH DIFFERENT OILS

Analysis Head: Gold, 0.608 Oz. per Ton; Iron, 5.2%

| Oil No. | Total Time, Min. | Total Oil, Lb. per Ton | Total Acid, Lb. per Ton | Total Alkali, Lb. per Ton | Gold Oz. per Ton | Gold % Extraction | Iron % | Iron % Extraction |
|---|---|---|---|---|---|---|---|---|
| 11 | 24 | 1.11 | 0.00 | 0.0 | 4.72 | 82.5 | 8.5 | 31.9 |
| | 22 | 1.11 | 3.68 | 0.0 | 6.12 | 75.8 | 17.2 | 41.1 |
| | 23 | 1.11 | 0.00 | 4.0 | 5.64 | 82.3 | 13.4 | 14.8 |
| 18 | 22 | 1.8 | 0.00 | 0.0 | 10.34 | 78.2 | 13.2 | 17.7 |
| | 21 | 1.5 | 3.68 | 0.0 | 11.52 | 78.0 | 14.3 | 19.6 |
| | 22 | 1.5 | 0.00 | 1.0 | 11.60 | 81.2 | 13.1 | 6.2 |
| 15 | 23 | 2.88 | 0.00 | 0.0 | 5.06 | 82.3 | 5.7 | 0.0 |
| | 21 | 2.88 | 3.68 | 0.0 | 13.80 | 74.8 | 9.6 | 11.8 |
| | 21 | 2.88 | 0.00 | 1.0 | 5.80 | 76.0 | 7.4 | 6.2 |
| 16 | 21 | 2.4 | 0.00 | 0.0 | 10.10 | 81.3 | 8.6 | 31.5 |
| | 21 | 2.4 | 3.68 | 0.0 | 12.60 | 81.2 | .... | 0.0 |
| | 21 | 2.4 | 0.00 | 1.0 | 7.88 | 78.7 | 11.7 | 27.3 |

TABLE 3. TESTS ON ORE C IN NEUTRAL, ACID AND ALKALINE SOLUTIONS WITH DIFFERENT OILS

Heads: Copper, 1.58%

| Oil No. | Total Time Min. | Total Oil, Lb. per Ton | Total Acid, Lb. per Ton | Total Alkali, Lb. per Ton | Copper % | Copper % Extraction |
|---|---|---|---|---|---|---|
| 11 | 20 | 0.92 | 0.00 | 0 | 15.95 | 29.3 |
| | 21 | 1.48 | 7.36 | 0 | | |
| | 21 | 1.29 | 0.00 | 6 | 16.15 | 32.6 |
| 18 | 20 | 1.8 | 0.00 | 0 | 16.45 | 51.2 |
| | 20 | 1.5 | 7.36 | 0 | 2.48 | |
| | 20 | 1.2 | 0.00 | 4 | 22.27 | 68.2 |
| 15 | 21 | 1.44 | 0.00 | 0 | 5.84 | 4.3 |
| | 21 | 1.44 | 7.36 | 0 | 2.77 | |
| | 23 | 1.44 | 0.00 | 4 | 18.17 | 23.1 |
| 16 | 17 | 2.1 | 0.00 | 0 | 4.50 | 33.6 |
| | 18 | 2.7 | 7.36 | 0 | 1.72 | 5.6 |
| | 23 | 2.4 | 0.00 | 8 | 7.94 | 3.9 |

cut down. No attempts to run tests in this manner were made. The relatively high grade of the heads in the tests on the Cripple Creek ore leaves tailing in all these tests too high to compare favorably with roasting and cyaniding. Hence, further work in adaptation of these oils to give higher extractions would have to be done. This is a question of mechanical manipulation with which every flotation experimenter is familiar. The extractions of the iron in the Cripple Creek ore are very poor with all the tests. As the ore was ground dry in a

laboratory sample pulverizer, this is not surprising, for pyrite is peculiarly sensitive to oxidation during such grinding and will not float well. Not being an important mineral in this case, the method of preparation of the sample did not matter. It is interesting to note that No. 11, the "wood oil," was the oil that gave best extractions of the iron. As was expected, the Utah Copper ore usually floated best in alkaline solutions, oils 11 and 15 doing the best work.

## 1916 Tungsten Production

All records for tungsten production by any country for 12 months have been broken by the output of the United States for the past six months. This production is estimated by Frank L. Hess at 3,290 short tons, carrying 60% $WO_3$, valued at $9,113,000, says a bulletin of the United States Geological Survey.

The domestic demand for tungsten was not satisfied by this enormously increased output over former years, however, as is shown by the importation of 1,520 tons of foreign ores valued at $3,449,311 during the first five months of the year. While most of this imported ore came from Peru, Bolivia and Argentina, some came from Mexico and Japan.

Imports of tungsten metal and ferrotungsten totaled 10 tons valued at $36,885, while exports for the first five months totaled only 4,906 lb. valued at $10,571.

By adding the domestic production and imports, estimating the imports for June, the American consumption amounted to roughly 5,100 tons of 60% concentrates valued at $13,278,000. Allowing a 20% loss in steel making, it seems probable that between 11,000 and 12,000 tons of new high-speed steel were made in using this tungsten supply.

Of the domestic production of 3,290 tons of $WO_3$ concentrates the various ores constituting this total were as follows: Ferberite, 1,495 tons valued at $3,590,000; scheelite, 1,404 tons valued at $4,322,000; wolframite, 201 tons valued at $613,000; and hübnerite, 185 tons valued at $587,000.

Colorado has regained its lead in tungsten production, having marketed between Jan. 1 and June 30 a total of 1,505 tons valued at $3,638,000, of which the Boulder district produced 1,494 tons. California sold 984 tons valued at $3,005,000, its higher-grade concentrates bringing higher prices. Nevada produced 461 tons valued at $1,432,000; Arizona shipped 175 tons valued at $565,000, while smaller quantities came from Alaska, Connecticut, Idaho, Missouri, New Mexico, South Dakota, Utah and Washington.

In the tungsten mining camps the excitement following the greatly increased prices was similar to that caused by important gold discoveries. Nederland, Colo., suddenly sprang from a hamlet of a few dozen homes to a town of more than 3,000 population, while east of Nederland two other settlements of several hundred souls came into existence. Atolia, Calif., jumped from a town of less than a hundred to several thousand population.

During the last six months 40 concentrating plants of various types and sizes were in operation on tungsten ores, and at the end of June there were 14 new mills under construction.

In the Boulder district 10 mills were put in operation, of which six were new, and at the end of June five old mills were being overhauled and three new ones were in course of construction.

At Atolia, Calif., the mill of the Atolia Mining Co. was burned, but rebuilt with enlarged capacity. Two mills were reported under construction near Goffs and one near Nipton. A smaller mill of the Atolia company was operated at Johannesburg. Many kinds of machines, largely of the dry-concentrator type, were used to extract scheelite from desert débris, between Randsburg and Atolia. Two mills, of 30 and 100 tons' daily capacity respectively, were erected near Bishop, Calif., to concentrate scheelite ores from contact-metamorphic deposits. The mill owners claim they can operate profitably on prices equal to those prevailing before the war.

In Nevada a mill was constructed near Toy, Humboldt County, and four more mills were erected in the Snake Range, in which tungsten deposits were found throughout a length of 50 mi. or more. The United States Tungsten Corporation operated an old mill at Tungsten, 12 mi. south of Osceola, and a small mill was also working on the east side of the range.

In Washington a mill was constructed on Tungsten Mountain, 35 mi. northwest of Oroville.

The prophecy made by the Geological Survey several years ago that the production of tungsten ores would probably be greatly increased with an increase in price, and that new deposits equal to those known might be found, has now received abundant confirmation.

## Foreign Trade in Copper

Exports of copper from the United States in June and the six months ended June 30 are reported by the Department of Commerce as below, in pounds:

| | June | Six Months |
|---|---|---|
| Ore and concentrates, contents | 298,199 | 1,909,706 |
| Blister and black copper | 672,938 | 3,687,953 |
| Refined—ingots, bars, etc. | 77,176,722 | 356,058,839 |
| Plates and sheets | 642,526 | 7,395,129 |
| Wire | 1,512,749 | 11,242,867 |
| Old and scrap | 124,296 | 160,224 |
| Total copper, lb. | 80,427,430 | 380,454,718 |
| Copper manufactures, value | $2,895,546 | $9,276,841 |

The weight of ore exported in June was 9,364 tons; of concentrates, 588 tons.

Imports of copper into the United States in June and the six months ended June 30 are reported by the Department of Commerce as below, in pounds:

| | June | Six Months |
|---|---|---|
| Ore and concentrates, contents | 18,161,173 | 80,267,710 |
| Matte, contents | 2,116,389 | 11,793,950 |
| Unrefined—blister copper, etc. | 23,723,976 | 141,047,879 |
| Refined—bars, plates, etc. | 112,000 | 2,618,392 |
| Composition, copper chief value | 47,717 | 446,758 |
| Old and scrap | 571,304 | 5,064,128 |
| Total copper, lb. | 44,732,559 | 241,238,817 |
| Copper manufactures, value | $8,102 | $26,067 |

Actual tonnage of copper-bearing material imported in June was 59,779 tons ore, 8,448 tons concentrates and 2,366 tons matte.

## Robert Safford Towne

Robert Safford Towne, a mining engineer long active in the development of Mexico, died on Aug. 3 in his apartment at the Engineers' Club, New York City. He was in his fifty-eighth year, having been born at Portsmouth, Ohio, a son of the late Henry A. Towne and Mrs. Harriet Nye Towne. Mr. Towne received his education at grade schools and at the Ohio State University, from which later institution he was graduated in 1879, receiving his degree of mining engineer a year later.

Mr. Towne was an officer in many Mexican corporations, most of which he was instrumental in organizing and over all of which he exercised active management. One of the largest interests was the Compañia Metalurgica Mexicana, operating the large lead-smelting works at San Luis Potosi, Mexico. In this company he occupied the position of president and treasurer, and was also a director. The company obtained supplies for its smelting plant from the mines of the San Pedro district, near San Luis Potosi, with which mines the company had long-time contracts and some of which it operated with its own men. The smeltery at San Luis Potosi is connected with the San Pedro mines by the Potosi & Rio Verde Ry., of which company Mr. Towne was also president and director.

Another large and important interest that Mr. Towne instituted is the Tezuitlan Copper Co., at Tezuitlan, Vera Cruz. This plant had been extremely active before the Mexican revolution and is one of the important copper-smelting centers in Mexico. Mr. Towne was president and director of the Mexican Northern Railway Co., and he was also president and director of the Alvarez Land and Timber Co., the Fresnillo Mining Co., the Mexican Lead Co., the Montezuma Lead Co. and the Soubrette Mining Co. He was also president of the Minerals Extractor Corporation and vice-president of the Metallurgical Engineering and Process Corporation.

Mr. Towne was a member of the American Institute of Mining Engineers, the Ohio Society and the New York Yacht, Engineers', New York, and Lawyers' clubs.

## New South Wales Mineral Production in 1915

The report of the New South Wales Department of Mines for 1915 has just been issued, and gives the figures of production shown in the accompanying table.

NEW SOUTH WALES MINERAL PRODUCTION, 1914 AND 1915

| Substance | Unit | 1914 | 1915 |
|---|---|---|---|
| Alunite | tons | 3,040 | 1,420 |
| Antimony (metal and ore) | tons | 36 | 636 |
| Bismuth (metal and ore) | tons | 15 | 18 |
| Coal | tons | 10,390,622 | 9,449,008 |
| Coke | tons | 304,800 | 417,753 |
| Copper (ingots, matte and ore) | tons | 6,607 | 6,793 |
| Diamonds | carats | 1,580 | 839 |
| Gold | oz. | 124,507 | 132,498 |
| Iron | tons | 75,150 | 76,318 |
| Iron, "oxide" | tons | 3,144 | 2,294 |
| Lead (pig, etc.) | tons | 25,989 | 30,305 |
| Lime | tons | 36,207 | 33,010 |
| Limestone flux | tons | 51,852 | 71,720 |
| Molybdenite | tons | 61 | 31 |
| Platinum | oz. | 244 | 56 |
| Silver (ingots and matte) | oz. | 2,871,559 | 3,237,432 |
| Silver-lead, ore, concentrates, etc. | tons | 337,019 | 282,776 |
| Shale (oil) | tons | 50,049 | 15,474 |
| Scheelite | tons | 57 | 33 |
| Tin (ingots and ore) | tons | 2,317 | 2,188 |
| Wolfram | tons | 130 | 50 |
| Zinc (spelter and concentrates) | tons | 359,319 | 190,916 |

In addition to the foregoing, marble valued at £4,187, opal, £6,403; portland cement, £415,000; building stone, £657, and sundry minerals and ores valued at £7,756 were produced in 1915.

The total value of the mineral yield in 1915 was £10,064,569, a decrease of £435,161 from that of the previous year. However, considering the disabilities under which the mining industry has labored during the continuance of the war, the production must be regarded as very satisfactory.

The number of persons employed in mining in 1915 is estimated at 31,411, a decrease of 6,059 from figures of the previous year.

## Appointments in the Engineer Officers' Reserve

The Officers' Reserve Corps is authorized by sections 37-40, 49 and 51-53 of the National Defense Act approved June 3, 1916. The regulations prescribed by the President to carry it into effect are published in general order No. 32, War Department, July 28, 1916, which also quotes in full the above-mentioned sections of the National Defense Act.

The following extracts from the above general order give the principal requirements of the regulations that apply to the Engineer Officers' Reserve Corps. A copy of the complete regulations will be furnished on request, which should be addressed to the Chief of Engineers, U. S. Army, Washington, D. C.

Applicants commissioned in the Officers' Reserve Corps will rank in the various sections according to grades and to length of service in their grades. Commissions will be issued for periods of five years. No age limits apply to the Engineer Officers' Reserve Corps.

Except as otherwise herein provided, a member of the Officers' Reserve Corps shall not be subject to call for service in time of peace, and whenever called upon for service shall not, without his consent, be so called in a lower grade than that held by him in said reserve corps. In time of actual or threatened hostilities the President may order members of the Officers' Reserve Corps, subject to physical examination, to temporary duty with the Regular Army, or as officers in volunteer or other organizations that may be authorized by law, or as officers at recruit rendezvous and depots or on other duty. They may be promoted to vacancies in volunteer organizations or to temporary vacancies in the Regular Army, as prescribed in the act. While reserve officers are on such service they shall be entitled to the pay and allowances of the corresponding grades in the Regular Army.

Department commanders and the Chief of Engineers, when authorized by the Secretary of War, may order reserve officers of their departments or corps to duty with troops in the field or at field exercises or for instruction for periods not to exceed 15 days in any one calendar year. While so serving such officers shall receive the pay and allowances of their respective grades in the Regular Army. These periods will not be extended except with the consent of the reserve officers concerned.

Enlisted men of the Regular Army and of the National Guard, both active and retired, if citizens of the United States, are eligible for examination for commissions in the Engineer Officers' Reserve Corps. No applicant will be examined who is an officer of the Regular Army on the active list or of the National Guard or who is not a citizen of the United States.

The examining board will ordinarily be composed of one officer of the Corps of Engineers, one member of the Engineer Officers' Reserve Corps, and one officer of the Medical Corps or the Medical Officers' Reserve Corps.

The mental examination of no applicant will be undertaken who, in the judgment of the board, is not physically qualified to discharge in active service all the duties of an officer of the grade in which the applicant seeks a commission in the Officers' Reserve Corps; nor of anyone who has any mental infirmity or deformity of body, or whose moral fitness has not been duly established.

No person shall be examined for appointment in the Engineer Officers' Reserve Corps unless he has a letter from the Chief of Engineers authorizing his examination. Such a letter to an applicant will be the acknowledgment of the receipt of his application.

If an applicant has served in the Regular Army of the United States, or in any of the volunteer forces of the United States, or in the organized militia of any state or territory or the District of Columbia, he shall submit his discharge papers for each term of service; if still in service of any of the organizations named, he shall submit recommendations of his immediate and higher commanders.

If an applicant has attended or pursued a regular course of instruction in any military school or college of the United States, or has graduated from any educational institution to which an officer of the army or navy has been detailed as superintendent or professor pursuant to law, he shall, if a graduate, be required to present a diploma of certificate of graduation from such military school, college, or educational institution, or, if not a graduate, a certificate showing the amount and character of training, theoretical or practical, satisfactorily completed thereat.

Every applicant will be subjected to a rigid physical examination, which shall include the ordinary analysis of the urine, and if there be found to exist any cause of disqualification which might in the future impair his efficiency as an officer, he will be rejected. Defects of vision resulting from errors of refraction which are not excessive, and which may be entirely corrected by glasss, do not disqualify unless they are due to or are accompanied by organic disease.

Candidates for appointment in the Engineer Officers' Reserve Corps will be examined either (a) for duty with combatant engineer troops or other duties in the service of the front, or (b) for special service on the lines of communications or other points in rear, including engineer work in connection with seacoast defenses, as hereinafter indicated. Officers appointed under (b) will not ordinarily be assigned to combatant duties but will be subject to such assignment whenever needed. The examinations shall be especially directed to ascertaining the practical capacity of the applicant, and the record of previous service and training of the applicant shall be considered as a part of the examination.

Military experience or training in the regular army, volunteers, or National Guard, or at training camps or educational institutions will be noted and reported by the board and considered in making the recommendations.

**Qualifications for Reserve Officers, Service of the Front**

1. For First and Second Lieutenants:

(a) The applicant must be an engineer in the active practice of his profession or some business immediately connected with, or concerned in, engineering matters.

(b) He must either hold or have qualified for the grade of junior engineer, civil, electrical, or mechanical or higher grade in the civil service, or he must be a graduate from an approved engineering college, or have been in the active practice of engineering for at least two years.

2. For Captains:

(a) The applicant must be an engineer in the active practice of his profession or some business immediately connected with, or concerned in, engineering matters.

(b) He must either hold or be eligible for the grade of assistant engineer in the engineer department at large, or a corresponding engineer grade in the civil service in another department of the Government service, or have held a commission in the Corps of Engineers of the Regular Army, or shall be a professional engineer not less than 28 years of age, who shall have been in the active practice of his profession for at least 8 years and have had responsible charge of work as principal or assistant for at least 2 years. The graduation from a school of engineering of recognized reputation shall be considered as equivalent to two years' active practice.

(c) Knowledge of the principles of military organization and operations, as illustrated in Infantry Drill Regulations, Parts I (to include School of the Company) and II, and Field Service Regulations, Part I and Part II (Articles I, II, IV, VI); and of the general principles of field fortifications, as illustrated in the Engineer Field Manual, Chapter V.

3. For Majors:

(a) The applicant must be an engineer in the active practice of his profession or some business immediately connected with, or concerned in, engineering matters.

(b) He must hold the grade of assistant engineer in the engineer department at large, or corresponding engineer grade in the civil service in another department, or have held a commission in the Corps of Engineers of the Regular Army not more than two grades below that for which he desires to be listed, or shall be a professional engineer not less than 35 years of age, and shall have been in the active practice of his profession for 15 years, who shall have had responsible charge of work for at least 5 years, and shall be qualified to design as well as to direct engineering work. Graduation from a school of engineering of recognized reputation shall be considered as equivalent to two years of active practice.

(c) In addition to fulfilling the qualifications given in paragraph 3 (a) and (b), the candidate will be required to pass an examination on the following subjects:

Drill Regulations—Parts I (School of the Company and Battalion only), II, III, Infantry Drill Regulations.
Field Service Regulations, entire text.
Duties of Engineer Officers and troops in war, as illustrated in the Engineer Field Manual and Bulletin No. 4, Vol. I, of the office of the Chief of Staff.
Coöperation between the various arms of the service, as illustrated in "Technique of Modern Tactics" (Bond and McDonough) Chapters VIII, IX, XI and XII.
All examinations will be oral.

**Qualifications for Reserve Officers, Special Services**

Candidates desiring appointment in special services must be qualified for at least one of the duties assigned to the Corps of Engineers by the following extracts from Army Regulations:

"1493. The duties of the Corps of Engineers comprise reconnoitering and surveying for military purposes, including the laying out of camps; selection of sites and formation of plans and estimates for military defenses; construction and repair of fortifications and their accessories; . . . the installation of electric power plants and electric power cable connected with seacoast batteries; . . . construction and repair of military roads, railroads and bridges; military demolitions; . . . In time of war within the theater of operations it has charge of the location, design and construction of wharves, piers, landings, storehouses, hospitals and other structures of general interest, and of the construction, maintenance and repair of roads, ferries, bridges and incidental structures, and of the construction, maintenance and operation of railroads under military control, including the construction and operation of armored trains."

No oral or professional examinations will be required, but recommendations of boards will be required in lieu of such examinations. Candidates will submit evidence of their actual employment in corresponding or higher positions in civil life and references to persons under whom they have been or are employed.

Reserve officers from the following civilian occupations will be required for the special services of the Corps of Engineers: Bridge engineers; constructing engineers (earth and concrete); constructing engineers (wharves, piers and buildings); electrical engineers (for small plants and power lines); highway engineers; mining engineers (skilled in tunneling and use of explosives); railroad engineers (construction and maintenance); railroad operating officials; sanitary engineers; topographical engineers.

War Department, Office of the Chief of Engineers,
Washington, Aug. 1, 1916.

## American Mining Congress Call

The nineteenth annual convention of the American Mining Congress will be held in Chicago, Ill., from Nov. 13 to 16 inclusive, with the La Salle Hotel as headquarters.

Coöperation between capital and labor is the declared keynote of the convention. A better understanding between employers and employees is one of the most important subjects for consideration, and the truth of the issues involved is to be told plainly but without giving offense. Coöperation is declared the greatest need of the mining industry. The great purpose of the convention will be to inaugurate plans by which all branches of the mining industry may work together for the solution of common problems.

In order that delegates may attend the discussion of only such questions as are of direct interest to them, the afternoon and evening sessions of each day will be divided into sections, each giving consideration to its special problems. A general meeting of the congress will be held on the morning of each day of the convention at which only subjects of general interest will be considered. These subjects will be grouped under the heads of safety, efficiency and conservation.

The entertainment committee will provide functions for time not occupied by the serious work of the convention, including trips to points of interest and a smoker and banquet. The management of the La Salle Hotel will make special rates to members of the convention who make reservations in advance.

## Exports of Sheet Zinc

We recently drew the attention of the Bureau of Statistics of the Department of Commerce and Labor to the probability that its statistics of the exportation of sheet zinc from the United States during the last year was seriously in error. The Bureau insituted an investigation of the matter with the result that a few days ago the following circular was issued:

Correspondence with collectors of customs has resulted in certain corrections of the export figures published in the successive issues of the "Monthly Summary of Foreign Commerce" for the period from July 1, 1915, to May 31, 1916. The changes represent transfers from the class entitled "Zinc plates and sheets" to that entitled "Zinc pigs, bars, etc., produced from domestic ore." The amended figures for those classes are as follows:

| Month of— | Zinc Pigs, Bars, Etc., Produced From Domestic Ore | | Zinc Plates and Sheets | |
|---|---|---|---|---|
| | Pounds | Dollars | Pounds | Dollars |
| 1915—July | 9,563,906 | 1,514,440 | 3,419,536 | 510,829 |
| August | 10,358,383 | 1,700,021 | 4,189,474 | 716,889 |
| September | 11,987,071 | 1,908,495 | 5,320,428 | 871,939 |
| October | 17,509,317 | 2,769,390 | 6,676,174 | 1,103,728 |
| November | 18,034,229 | 3,042,816 | 2,004,081 | 361,089 |
| December | 16,250,983 | 2,871,662 | 3,156,531 | 539,087 |
| Six months total | 83,703,889 | 13,806,824 | 24,766,224 | 4,103,561 |
| 1916—January | 17,509,686 | 2,974,223 | 3,457,116 | 636,747 |
| February | 18,428,050 | 3,136,523 | 2,227,345 | 435,929 |
| March | 14,852,831 | 2,598,389 | 1,489,655 | 304,083 |
| April | 16,608,797 | 2,943,719 | 1,657,134 | 408,139 |
| May | 16,226,961 | 2,893,519 | 939,121 | 207,133 |

## Greenland Cryolite Mining

Cryolite has been found in commercial quantities at Ivigtut, an Eskimo hamlet on the southern coast of Greenland. The cryolite deposit is reported to be a solid mass, having surface dimensions of about 200 ft. by 600 ft., and it has been worked as an open cut to a depth of about 150 ft. The deposit widens with depth, and the depth is unknown.—*The Chemical Trade Journal and Chemical Engineer.*

**Shattuck Arizona Copper Co.'s** production for June, 1916, was 1,446,080 lb. copper, 61,889 lb. lead, 24,636 oz. silver and 367.02 oz. gold.

# Editorials

## The Situation in the Metals

About three months ago there was a cessation in the feverish activity that previously had prevailed in the metal market for a long time, and in all cases there were recessions in price, which in some cases were very severe. The last was true especially of zinc, antimony, and tungsten. The prices for copper, lead, and iron and steel declined, but in nothing like the same proportion as the other metals. However, with the feelings of pessimism over financial and commercial prospects that began to develop, there was an expectation in many quarters that copper, lead, and iron and steel would meet with more or less the same fate as the other metals. There were to be no more war orders. The clock was considered to have struck twelve six months or more ago, and some financial danger signals were believed to be flying. This pessimism was about at the deepest just at the mid-year.

As July wore on, there appeared to be a change of sentiment and a growing appreciation that what had been happening was only a natural readjustment of conditions that were still sound and excellent. In Great Britain there are two views among economists. The optimistic, whereof Sir George Paish is the great exponent, minimizes the destruction of wealth by the continuance of the war. The other, the pessimistic school, whereof Francis W. Hirst, who recently retired from the editorship of the *Economist,* is the chief exponent, prophesies that a prosecution of the war for only a few months more will result in catastrophe for the whole world. The minds of a good many people in this country were probably unduly colored by the latter view. If we may rely upon so excellent a practical authority as the National City Bank, which in its last circular called attention to the very slight extent of the diminution of the gold reserves of the European nations during the last year, there is good reasons for adhering to the opinion of the optimistic school of economists.

Anyway, people began to feel better during July. The advance in money rates proved to be but temporary. Other danger signals did not appear to be so positive as previously they were regarded. Even then came some further ammunition orders, rather to the surprise of everybody. This improvement in feeling was reflected in the metal markets, which is the subject of our present discussion.

Let us start out with the premise that any great rise in the value of a commodity automatically brings about the corrective thereof through the stimulation of new production, and sooner or later there must be a recession from every high price. That is going to happen with copper and steel, just as it has already happened with zinc and antimony, but by virtue of natural conditions it may not happen for a long time. In other words, there are at present some fundamental differences in the positions of copper and zinc, and there are some special factors that are playing a part in the lead market.

The position of copper is still phenomenally strong. The production of the miners and smelters has increased a good deal, but that of the refiners has not increased in the same proportion and lately has been checked considerably by the diminished output of labor. The refiners have no stocks and are finding it difficult to keep up with the deliveries that they have contracted to make. Were it not that copper manufacturers are to a considerable extent in the same fix there would be serious trouble. The principal producers have without exception sold all of their expected output up to about Oct. 1. There has been no large buying since about the first of May. Even the French and British governmental contracts do not run generally beyond the end of this year. There is reason to anticipate that large buying of copper will soon have to take place. The expected demand will come in a market that is already firm. The situation is well reflected in the sharp rally in copper that occurred in the latter part of July. A precisely similar rally happened in the market for iron and steel products.

With zinc the situation is quite different. The high price for that metal was a direct invitation to Tom, Dick and Harry to produce it. The conditions of the zinc business permit of a rapid increase in plant for the purpose of production—such a rapid increase as would be impossible in copper and steel. The statistics of spelter production in the first half of 1916, just issued by the U. S. Geological Survey, throw light on this. The output in the first half of 1916 was 316,255 tons compared with 272,987 tons in the second half of 1915. [We use the Washington figures for the latter in order to have an accurate comparison. These figures represent only the spelter derived from ores, and do not include what the smelters get from dross and other waste products.]

The increase in production in the first half of 1916 was less than what everybody was prophesying early in the year. We find the probable explanation in the knowledge that both the shortage and increasing inefficiency of labor have been restrictive factors. One large new plant that was expected to be running at full capacity early in 1916 is not yet up to 75% of its capacity, owing to inability to secure the requisite number of smelters. On the other hand, numerous plants that used to make 85 to 90% extraction are now getting much less, while some of the small new plants are simply butchering their ores.

However, although the production in the last semester was not as large as expected, it is manifest that it was larger than necessary, for stocks on hand increased from about 14,000 tons at the beginning of 1916 to 24,000 tons at the mid-year. It is obvious, therefore, that the market in declining reflected correctly the conditions.

In lead, the statistical position appears to be almost as good as is that of copper. Early in 1916 there was an acute position in lead to which the diversion of the output of an important Coeur d'Alene producer was a contributory factor. That producer, having decided to smelt its ore on its own account, was obliged to deprive the

market of a large supply while it was stocking up its bins and saturating its smelting and refining system. That having been done, the lead from that producer began lately to come on the market again in large quantities, and in order to effect a disposition of it a very sharp competition was instituted, which produced a general nervousness and something like a temporary demoralization. At all events this competition was the direct cause of the recent reduction in the price of lead.

The prices for antimony and tungsten have declined to relatively low levels. Instead of being from five to ten times above normal, they are now only one and a half to two times above it. The high prices were a direct invitation to everybody to produce all they could, and the plants required for the production of these metals being relatively easy to provide the corrective conditions came quickly into operation.

## A Clearing House for Myths

There ought to be a clearing house for pet theories, alias myths, so as to settle those that are directly in conflict, as is frequently the case. This refers especially to ideas about market conditions, that many people cherish when things happen that they do not like.

Thus when spelter went up to dizzy heights, our friends in Britain said, and probably believed, that it was due to a German or German-American plot to mulct them. When spelter went down, American producers averred with equal assurance that it was a result of a British conspiracy to skin them.

Copper has been purchased lately for the British and French governments by a great American banking house. The price rose to a high figure and then receded somewhat. In Great Britain there has been criticism of the purchasing of copper through that banking house owing to its own important interests in copper production. At the same time American producers have been intimating that the abstention of the aforesaid banking house from the market for several months was a part of a wily scheme to depress the market in the interest of its foreign clients.

Some people say that copper declined in nothing but a nominal way. Others say that it declined on resales by the foreign governments who sought thus to depress the market in order to pave the way for further purchases.

So it goes. The only people who get any amusement out of it are those of a humorous cast of mind.

## The Proposed Tax on Munitions

The more the proposed tax on munitions is examined the more unreasonable and unfair does it appear to be. Take the tax on explosives—8% proposed—and the first thought is that this will fall chiefly on the Du Pont and Hercules companies, which have been making a mint of money and can well afford it. But on second thought the idea occurs to us that explosives are extensively used in the mining industry and perhaps the manufacturers will be able to spread the tax among the consumers.

There is another thought. Two years ago the cotton planters were in a desperate condition. Clubs were organized to help them and "Buy a Bale of Cotton" became a national slogan. Then the Du Pont company got a war order and bought several bales wherewith to make gun cotton. Before long it purchased approximately 1,000,000 bales and the cotton planter was saved. Indeed, the price for short-fiber cotton advanced from 2c. to 8c. per lb. This was proportionately far more than the advance in copper. Why should the copper producer and the explosive manufacturer be taxed and the cotton planter go scot free?

Incidentally the Du Pont company reckons that its tax will be $21,000,000 for 1916, or $38 per share, which is more than the net profits of the company in the three years 1912-14.

The Senate appears to be paying some attention to arguments like the above, for this week the Finance Committee struck out the varying rates provided in the House bill for munitions of war, explosives, copper, etc., and substituted a uniform rate on all of those things. Moreover it decided to add to the list steel billets, ingots and blooms, zinc, lead, denatured alcohol, cotton linters, and chemicals actually used in the manufacture of munitions. It is not explained why the list should be cut short with them and should not be extended so as to comprise canned meats, army rations of various kinds, antimony, quicksilver, tungsten, shoes, stockings, harness, saddles, blankets, barbed wire, kerosene, gasoline, locomotives, and a great variety of other articles that went to make up the military exports of more than $3,000,000,000 during the last two years.

However, it is evident that the excise bill is being completely made over in the Senate and what it will be when completed nobody yet can say.

## Labor Conditions

The National City Bank in its last circular on business conditions calls attention to the alarming increase in the inefficiency of labor, referring to this matter in the following very moderate words:

> It is a deplorable fact that there are circumstantial and authentic reports going to show that labor, in some instances, instead of being inspired by higher pay to greater productiveness, is becoming less efficient. In one instance under our observation, a large employer, whose attitude toward labor is that of sympathetic consideration, reports that after raising wages three times within a year the output per man is in serious degree less than before. The superintendents in immediate charge of operations attribute these results to indifference, loss of discipline, and the fact that other jobs can be easily had. It is needless to say that this development is disappointing to all who are sincerely interested in seeing the standard of wages and of living advanced, but it illustrates the fact that normal progress is by gradual rather than revolutionary processes.

The independence of labor is the natural result of scarcity. The demand for it has increased, while the supply has been diminished both by the cessation of immigration and the return of workers to Europe. With this independence has come about an inefficiency that is due to ignorance.

The attitude of labor is one of the disturbing features of the present situation. Its blighting effects are being experienced in copper smelting, zinc smelting, and other metallurgical industries, as well as in manufacturing industries in general. It is discouraging to see the discountenancing of efficiency obtaining the sanction of the American people collectively through acts of Congress, one of which proposes to make it illegal to institute time studies in governmental work. We imagine that the movement for the abolition of efficiency systems does not come from the men themselves so much as it does from

the walking delegates who foresee a curtailment of their power, activity and income. The workmen unfortunately do not, in their ignorance, appreciate what is good for them. However, there is the underlying desire of human nature to throw thrift to the winds, to live from hand to mouth, and to have a good time while the going is good. Therefore, if with present circumstances a man can earn as much in five days as he used to in six, and the income is sufficient, why work any more than five days?

## BY THE WAY

The *Boston News Bureau* notes that Gen. Luis Herrera has posted in Parral a decree to the effect that Carranza currency must be accepted at rate of 20c. silver on dollar throughout district, and that any merchant, foreign or native, refusing to accept money at this rate will be shot. Testimony of one witness is all that is necessary to convict.

⁂

There was a rumor in metal circles, said the New York *Sun,* which, however, lacked confirmation, that the concern which furnished the largest part of the consignment of metal supposed to have gone to Germany on the giant submersible the "Deutschland" was sold to Germany by the American Smelting and Refining Co. Metal men were hugely delighted at this report, pointing out that there was little chance of that company getting on the British blacklist for this trading with the enemy, owing to the fact that Great Britain and her allies are themselves forced to buy from this concern the copper and other metals which they find so necessary to carry on their warfare against Germany.

⁂

A correspondent whose veracity in small matters has hitherto remained unquestioned writes the following from one of the mushroom camps of the desert: "The other night Chuckawaller Pete's thirst emporium caught fire. The joint was a mass of flames when the camp volunteer fire department arrived. Prompt measures were necessary to avoid a total loss, but the mine bookkeeper held up the extinguishment of the blaze. He set out to figure which was the cheapest—to let the shack, constructed of lumber costing $150 per thousand, burn down, or put it out with water hauled 15 miles and costing $8 per barrel. While he was figuring, the shack burned down and we never did hear which way the figures pointed."

⁂

Senator Penrose really ought to know better, for he has traveled much in the West and both he and his brothers are extensively interested in mines. There was an exchange of partisan musketry in the Senate on Aug. 2. Senator Penrose cited as an example of Democratic extravagance the passage of a bill in the House appropriating $325,000 for a public building at Tucson, Ariz., a town of 20,000. Senator Penrose pronounced it "Tukson."

"The Senator criticizes and he does not even know how to pronounce the name of the town," shouted Senator Mark Smith, of Arizona, who is urging on Congress the improvement of Tucson. "Does the Senator from Pennsylvania know the amount of public business to be carried on in this building?" demanded Mr. Smith.

"I was there a few years ago," replied Mr. Penrose, "and I have a distinct recollection that there were more coyotes than voters."

"There are more gray wolves—timber wolves—in Pennsylvania than voters," shouted back the Senator from Arizona, red with anger.

After some further senatorial amenities attention was redirected to the affairs of the nation.

⁂

Now is the time of terrific summer heat in Arizona mining camps, and mine managers may possibly be excused for economy of effort in penciling a note. Two neighboring mining companies of a certain camp are in the habit of exchanging courtesies. One day when the local phone was temporarily out of order, Manager W. in an exasperated hurry wrote the following note: "Tell Manager C. offer him 15 bones for roll mill hose f.o.b. warehouse, R. S. V. P." In an hour back came the reply by messenger, and great was the indignation of W. when he read: "C. says W. can g. t. h."

About this time the phone trouble was remedied and W. called up C. forthwith. "I never said any such thing," came the laughing reply over the wire. "I told the bookkeeper you could 'get the hose,' and he merely copied your style of abbreviated writing in his answer."

⁂

Some of the viscissitudes of military control of industries were related at the recent meeting of the Magadi Soda Co., Ltd., in London, on June 20. This company has a 99-year lease of a natural soda deposit about 30 mi. square, known as Lake Magadi, in British East Africa, and has built a branch line connecting with the Uganda Ry., to reach the port of Kilindini. The foreman reported that operations had been suspended at the lake, owing to the war. The nearly completed works at Irlam were offered to the munitions department of the government when its directors heard that they were in need of a factory of this type, and offered to put the factory at the disposal of the government on behalf of the shareholders, the government paying 5% interest on the capital and amortization for the period the factory was used, and, of course, the government was expected to make good any damages done. Accordingly, the directors learned that the munitions department had commandeered the works and were later appalled to find that it was not the government's intention to use the works as they were, but to dismantle them and to remove the machinery to the works of one of the company's competitors. The directors entered a protest against this action, but without result. Owing to the commandeering of the company's railroad no shipments could be made, although orders had been received for the product. The company entered claim for the price of the material and buildings. The directors offered to let the government have the whole of the material and buildings in the works at the price that it would cost the company to replace. This, however, was refused, and the ministry of munitions referred the directors for compensation to the governing committee. The directors also entered a claim for compensation for use of the railways and water supply and buildings, but no decision has been reached. There are many uncompensated injuries to noncombatants in time of war, but sending one's equipment to a rival would seem to be an unnecessary and rather irritating one.

## PERSONALS

**George Watkin Evans,** of Seattle, is East on a business trip.

**Russell P. Leibee** has gone from Patagonia, Ariz., to Kingston, Penn.

**Bond Coleman** has gone from Douglas, Ariz., to Esqueda, Sonora, Mexico.

**D. F. Hewett,** of the United States Geological Survey, is in Peru, South America.

**A. E. Hall** is superintendent at the mine and mill of the Sable River Copper Co., at Massey, Ont.

**P. Kirkegaard** has been examining the property and mill of the Sable River Copper Co. at Massey, Ont.

**Pope Yeatman** will resume his independent practice as consulting mining engineer, beginning Sept. 1.

**Ralph Arnold,** of New York, is in Venezuela, where he will conduct some investigations in the petroleum dsitricts.

**Douglas Walker,** salesman for the Snyder Electric Furnace Co., in charge of the Chicago district, has been appointed sales manager.

**B. A. Robinson,** assistant secretary of the American Institute of Mining Engineers, is attending the military training camp at Plattsburg, N. Y.

**Ernest Marquardt** has joined the petroleum division of the staff of the Associated Geological Engineers, and will be detailed to service in Oklahoma.

**Nathan O. Lawton** will be engaged for the next two months at the mine of the Vermont Copper Co., South Strafford, Vt., looking after the reopening of the mine and the development of the property.

**David F. Baker,** who has been connected with the blast-furnace department of the Broken Hill Proprietary Co. at Newcastle, N. S. W., is now in the United States and will take up permanent work here.

**Robert Bryce,** of Cobalt, Ont., has been making some examination at Whiskey Lake and Sudbury districts. He made an examination of the Sable River mine where flotation is being used on the chalcopyrite ores.

**James F. Callbreath,** secretary of the American Mining Congress, is spending a good deal of time in Chicago looking after the preliminary arrangement for the annual convention, which will be held in that city in November.

## OBITUARY

**Thomas Francis,** a mining engineer of Missouri, died at Bevier, Mo., on July 24,, aged 75 years.

**Louis Rosenfeld,** one of the owners of the Eagle-Shawmut mine in Tuolumne County, Calif., was found dead in Golden Gate Park, San Francisco, early in the morning of July 20.

**W. Vaughn Pettit,** a mining engineer of Philadelphia, Penn., was killed in action in France during the latter part of June, while serving with the British Royal Engineers. Mr. Pettit was 41 years old and a bachelor. He was a graduate of Lehigh University. Mr. Pettit enlisted in the British army about a year ago.

**Reuben Kay Edwards,** a well known furnace operator and contractor, of Birmingham, Ala., died on July 29. He was formerly superintendent of the old Mary Pratt furnace, long since torn down, and later was connected in the same capacity with the Sloss-Sheffield company. In the past five years he had been in the contracting business. He leaves a widow and two sisters.

**J. J. Abbott,** a pioneer mining engineer of Colorado and prominent throughout Denver and the mountains, died at Auburn, Me., on July 31. He had been in ill health, which obliged him to give up his professional work about a year ago. He went to California in the spring of 1915 to seek relief from a breakdown caused by high blood pressure. He returned to Denver last February and later went to Maine, where two sons and two daughters reside. The funeral will be held there.

Mr. Abbott was born at Uxbridge, Mass., in 1850. He was a graduate of Yale and of the Sheffield Scientific School. In 1876 he went to Colorado and settled at Lake City.

He removed to Denver in 1898 and followed his profession until ill health forced him to retire.

## INDUSTRIAL NEWS

**Rix Compressed Air and Drill Co.,** of San Francisco, Calif., has moved to 505 Howard St., San Francisco.

**Encinitas Cash Store,** Encinitas, San Diego Co., Calif., is supplying California grinding pebbles in all sizes from 1 to 6 in. in diameter.

**Norton Company,** Worcester, Mass., has issued its catalog for 1916, showing a comprehensive line of Alundum refractories for laboratories and industrial works.

**The Asbestos Protected Metal Co.,** of Pittsburgh, announces the appointment on Aug. 1 of Melbert W. Taber, manager of its Detroit office, in the Penobscot Building.

**The Cement-Gun Construction Co.,** 900 South Michigan Ave., Chicago, reports it is waterproofing a coal mine for the Cottonwood Coal Co., Lehigh, Mont.; and waterproofing a coal mine for the Alden Coal Co. at Farmington, Ill.

**The Morse Bros. Machinery and Supply Co.,** of Denver, has purchased the steam-power plant of the A. V. plant of the American Smelting and Refining Co. at Leadville and is removing it to their Denver warehouse for resale.

**Colorado Iron Works Co.,** Denver, announces that L. G. E. Bignall has joined its sales organization. Mr. Bignall's wide experience gained during several years' service as sales engineer for the Mine and Smelter Supply Co., at El Paso, Tex., and sales manager for the Denver Engineering Works Co. well equips him for this work.

The distinction of furnishing the United States Navy with its first kite balloon has fallen to the **Goodyear Tire and Rubber Co.,** Akron, Ohio. Kite balloons are so called because of the method of rigging, which is similar to that of a boy's kite. They are also known as captive balloons from the practice of holding them captive at any height desired by means of a wire cable attached to balloon rigging. The balloon which has just been delivered to the Navy was designed by Goodyear aëronautical engineers and made entirely in the Goodyear factory. It has been placed in commission at the U. S. Navy aëronautic station at Pensacola, Fla., and is 81 ft. in length while its largest diameter is 22 ft. Hydrogen gas is used in inflating the big sausage-shaped bag. This gas is produced by a simplified process by the use of a hydrogen generator.

## NEW PATENTS

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ALUMINA—Crystalline Fused Alumina and the Manufacture Thereof. Frank J. Tone, Niagara Falls, N. Y., assignor to The Carborundum Co., Niagara Falls, N. Y. (U. S. No. 1,192,709; July 25, 1916.)

ALUMINATE—Producing Aluminate from Alunite. Paul R. Hershman, Chicago, Ill. (U. S. Nos. 1,191,104; 1,191,105 and 1,191,106; July 11, 1916.)

AMALGAMATOR. Albert E. Vandercook, Alameda, Calif., assignor to California Macvan Co. (U. S. No. 1,192,478; July 25, 1916.)

BLAST-FURNACE DISCHARGE ARRESTER. Edwin E. Slick and Edgar W. Clarke, Westmont Borough, Penn. (U. S. No. 1,191,541; July 18, 1916.)

CLASSIFIER — Ore-Classifying Machine. Selden Irwin Clawson, Salt Lake City, Utah. (U. S. No. 1,191,280; July 18, 1916.)

CONCENTRATOR—Ore Concentrator. Jacob Lampert, Rapid City, S. D. (U. S. No. 1,192,534; July 25, 1916.)

CRUSHER. James W. Boileau, Chicago, Ill. (U. S. No. 1,191,494; July 18, 1916.)

CRUSHER—Rock and Ore Breaker. Thomas W. Capen, Milwaukee, Wis., assignor, by mesne assignments, to Allis-Chalmers Manufacturing Co. (U. S. No. 1,191,564; July 18, 1916.)

CRUSHING—Stamp Mill. Henry L. Doherty, New York, N. Y. (U. S. No. 1,192,997; Aug. 1, 1916.)

DREDGING—Apparatus for Separating Materials of Different Specific Gravities. Charles Schifferle, San Francisco, Calif., assignor to The Yuba Construction Co., San Francisco, Calif. (U. S. No. 1,190,466; July 11, 1916.)

DRILL—Rock Drill. William August Smith, Denver, Colo., assignor of one-half to William W. Hassell, Colorado Springs, Colo. (U. S. No. 1,191,842; July 18, 1916.)

SINTERING—Cover for Sintering Pans. Frank D. Carney and Richard V. McKay, Steelton, Penn. (U. S. No. 1,190,513; July 11, 1916.)

ZINC—Metallurgy. Henry Swift Kimball, St. Louis, Mo., assignor to American Zinc, Lead and Smelting Co., Boston, Mass. (U. S. No. 1,189,830; July 4, 1916.)

# Editorial Correspondence

**SAN FRANCISCO—Aug. 2**

**Mine-Tax Assessments in Tuolumne County** have been reduced by the board of equalization in application to a large number of mining properties, including the Rawhide, App, Heslop, Jumper, Golden Rule, Tarantula and others. The reductions apply to the mines and equipment and total a large amount; the separate reductions run from $500 up to more than $25,000. A total reduction of $73,700 was made to the Central Land Co. in favor of the Rawhide, App and Heslop, which includes surface equipment. The Rawhide is being developed by the Pittsburgh Silver Peak Mining Co. and the App and Heslop are in the holdings being operated by W. J. Loring and associates. The encouragement thus given to investors and operators in Tuolumne County will not be confined to men who are able to work on a large scale, but will apply to a number of smaller owners who might not be able to work at all under a continued system of high taxation.

**Oxygen May Be Explosive,** when made by the electrolytic process, through contained hydrogen. This is the conclusion of the California Industrial Accident Commission, resulting from investigation of accidents due to the explosion of oxyacetylene-welding apparatus at the Mountain Copper Co. shops, Hercules Powder Co. and the California Artistic Metal and Iron Co. These accidents all occurred in the first half of July and resulted in a total of seven deaths. All of the apparatus was furnished by one company, and as the accidents were similar, the apparent cause of the explosion was more easily determined. However, the commission has not made any public statement as to its determination in that respect; but has merely issued a warning to all persons using oxyacetylene-welding apparatus that it is unsafe to use oxygen for this purpose without first determining that it does not contain hydrogen or other gases which with oxygen would form an explosive mixture. Experiments are being made to determine definitely the explosive limits of such mixtures. Users are advised to reject oxygen containing 2% hydrogen.

**Conditions at the North-End Comstock Mines** in the last half of July were particularly encouraging to the operators since the meeting of the United Comstock Pumping Association, held on July 21, decided to reduce the water level from the 2,700-ft. to the 2,900-ft. point. This has been in contemplation for several weeks and Superintendent Whitman Symmes, engineer in charge, was previously in San Francisco getting estimates upon costs of necessary electrical equipment. The result of the investigation was satisfactory to the Pumping Association and the work of unwatering will proceed as soon as the necessary installations are made. The pumps and other machinery used in unwatering from the 2,500 to the 2,700 levels are available, but additional equipment is necessary. The estimate for unwatering to the 2,700 level is said to have been $25,000, but the actual cost was $17,000. Mr. Symmes reports that the additional 200 ft. will be unwatered at a still smaller cost. It is known that the orebodies extend to the lower levels but no exploration was done by the early-day operators. The production of the north-end mines in the past two or three months has been encouraging, the Union showing large amounts of high-grade ore, while improvement in the Mexican, Ophir, Con. Virginia and other properties also adds to the encouragement. The Mexican mill is being operated on large tonnage from the Union and the mill sheet for June showed that Sierra Nevada shipped 262 tons that netted $2,254. The Comstock Leasing Co. which will operate the Chollar and Potosi is hurrying installation of mill and tramway, expecting to be operating early in August.

**BUTTE—Aug. 5**

**Monument to Mark First Gold Discovery in Montana,** the gift of Mrs. Mary E. Morony, of Deerlodge, to the Montana Society of Pioneers, is now being prepared in New Hampshire and will be erected this fall in Powell County on a bar between the Northern Pacific and the Milwaukee tracks at Gold Creek, the spot where gold was first discovered in Montana. The monument will be an 18-ft. granite shaft. Former Senator W. A. Clark has been invited to deliver principal address at the dedication ceremonies.

**Anaconda Copper Production** for July shows an increase of 100,000 lb. over the reported production for June, the total for July being 28,200,000, representing the output of the Washoe and Great Falls smelteries; this may be compared with 22,100,000 lb. for July, 1915. The company's production by months for the first seven months of 1916 follows: January, 23,200,000 lb.; February, 23,300,000; March, 26,600,000; April, 23,300,000; May, 30,000,000; June, 28,100,000; July, 28,200,000; a total of 192,700,000 lb., an average of 27,528,000 lb. per month. The rate of production is 330,000,000 lb. for the year. John D. Ryan, president of the Anaconda company, is in Montana on his annual visit and tour of inspection, expecting to remain in the state about a month. He is quoted as saying in an interview: "The copper business has had two months of dullness, succeeding a big business. As comparatively little copper has been traded in the past two months prices have dropped 5 or 6c. per lb., but the market is recovering and a good buying movement is starting. I am expecting higher prices than have prevailed since June 1. In the first few days in August quotations again ranged above 25c. per lb., and I have no doubt that the average during the month of August will be above that figure and that miners wages will again advance under scale regulated by the price of copper. The mines of the company in Butte look better than they have done in years, and production is being maintained at a satisfactory rate. The zinc plant at Great Falls is nearly completed and will be ready to start operations in two weeks. The zinc concentrator at Anaconda will be ready then to furnish product for the electrolytic plant to treat. These plants were begun last September and have been completed before the time promised by the engineers in charge of the construction."

**DENVER—Aug. 3**

**Purchase of the Cresson Mine**—the mine of vug fame—is announced from Cripple Creek as accomplished, the price named being $4,200,000 or at the rate of $3.50 per share. The new officers of the company will be: President, A. E. Carlton; vice-president, Claude K. Boettcher; secretary, A. J. Zang; treasurer, E. P. Shove; general manager, Richard Roelofs. Other directors are T. B. Burbridge, Charles M. MacNeill, Spencer Penrose, Irving T. Snyder, Adolph Zang and L. G. Carlton.

**The Lead in Tungsten Production** has been regained by Colorado, according to the statement of the U. S. Geological Survey. The output is estimated for the first six months of the year as having a gross value of $3,638,000. Fred Carroll, state commissioner of mines, says that the state's production of gold and silver for 1916 will range around $30,000,000 and that the total production of gold, silver, lead, zinc, copper and tungsten will probably have a value of about $100,000,000.

**Leadville's Two Great Unwatering Operations** have been attended by unforeseen misfortune. After water had been lowered to the bottoms of both the Penrose and the Harvard shafts, heavy flows developed and have persistently prevented the prosecution of development at depth. No satisfactory explanation has been advanced to account for the flow in the Penrose, which appears to issue from the floor of the bottom level, but Manager H. S. Lee, of the U. S. Smelting, Refining and Exploration Co., believes the Harvard is taking water from Evans gulch and he is accordingly constructing a great flume to carry the creek past the property. Both enterprises will be carried through despite these obstacles, as they were both formerly operated at present depths and are known to contain good reserves of valuable ores.

**SALT LAKE CITY—Aug. 4**

**Utah Ore Sampling Co.,** owning and operating sampling mills at Park City, Murray and Silver City, will increase its capitalization from $200,000 to $300,000, by issuing another 100,000 shares of stock. The company has handled an unusually large tonnage during past months and is planning the erection of a fourth sampler, to be built at Murray. The Tintic sampler is at present working one shift, handling a somewhat reduced tonnage (400 tons daily) owing to less lower grade ore being produced there.

**Grading for the New Leaching Plant** of the Utah Copper Co., near the Arthur mill at Garfield, has been practically completed. Work of installing the equipment will depend on when supplies, building material, steel, etc., can be delivered. The capacity will probably be 3,000 to 5,000 tons per day at the beginning, with provisions for handling a larger tonnage. Concrete leaching tanks, lined with acidproof asphaltum material, are to be used. D. C. Jackling and engineers of the company are in Salt Lake City going over the plans. The company has set aside $2,500,000 for the under-

taking. The capacity of the Arthur and Magna mills is being gradually increased, by additions and through improvements in handling the ore. Additional flotation equipment is also being installed. During June the copper production amounted to 17,877,432 lb. as compared with 15,950,215 lb. in May. The July production is expected to be greater than that for June, and the output for the year will be about 180,000,000 lb. There was recently handled in one day 44,000 tons of ore.

### JOPLIN, MO.—Aug. 5

**Another Slump in Ore Prices** on both zinc and lead during the last week in this district tended to check development work and caused several more mines to close. The turn in for the week amounted to less than 4,000 tons, and it is expected yet smaller shipments will be made if the price does not improve. Several mines in the west Joplin camp were closed down the latter part of the week, on account of lack of water and it is becoming increasingly difficult to get sufficient water for milling.

**Three Ambitious Prospecting Campaigns** have just been launched in the Kansas portion of the district. These campaigns will cover the prospecting of over 6,000 acres of virgin territory and should add materially to the known resources of the field. Of these three campaigns, the largest is that of a group of interests said to be associated with Boston zinc companies and involves the development of over 4,000 acres immediately north of the Oklahoma line and west of Baxter Springs, Kan. There have been a number of drill holes put down already and some strikes reported and a number of drill rigs are being sought to place at work upon the land. The second largest undertaking is that of a group of men already interested at Picher and Cardin. The development of 1,200 acres near Columbus, Kan., has just been announced as a part of their activities during the remainder of the summer and fall. This acreage is south of Columbus where there have been rumors of strikes during the last two years, but which have never been developed. The third campaign is that announced by the Delaware Zinc Co., which holds leases upon 1,000 acres north and south of Picher, Okla., about half of the acreage only being in Kansas. The latter work is in charge of Haywood Scott, of Joplin, and he has placed about 10 drill rigs at work during the last fortnight. It appears to be the ambition of all of these concerns to develop large acreages and the undertakings are being aided by the farmers by the granting of low rates of royalty and advantageous terms of working the ground. With the steady growth of the Miami and Commerce camps northward it is the belief of those interested in that field that the mineralized zone will extend far into Kansas. It would bring into the zone a large area of prospective mineral-bearing ground beyond Spring River, which has hitherto been considered as limiting the west side of the Joplin district.

### DULUTH—Aug. 5

**July Iron-Ore Shipments** were 9,750,517 tons, the greatest for a single month in the Lake Superior district. Total shipments to Aug. 1 are slightly over 29,300,000 tons. Should the same ratio of increase prevail throughout the season, the 1916 tonnage would pass the 60,000,000 mark, or five to ten million tons in excess of the rosiest expectations. Last year but 44,000,000 tons were shipped down the Lakes, while the record season of 1913 showed but 49,000,000 tons. The new Steel Corporation steamer "Wm. A. McGonagle" recently took on her maiden trip a cargo of 12,677 tons of iron ore.

**Prevailing Wages in the Chisholm District** were under discussion when the Mesabi Range strike started. Recently, Supt. A. Y. Peterson, in charge of the Oliver Iron Mining Co.'s operations in the Chisholm district, permitted press representatives to examine the company's pay rolls to ascertain the truth or falsity of the I. W. W. statements regarding the rate of wage paid to miners in the district. The examination disclosed the fact that 544 men per day were employed on contract work during May and 540 men during June. During May these men worked 14,147.25 shifts with net earnings of $48,067.86, an average rate per day of $3.397. During June they worked 10,318.75 shifts, net earnings $36,482.94, or an average of $3.535 per day. A tabulation of the average rates of wage of contract miners in the district showed the following for the two months stated:

| | | | |
|---|---|---|---|
| Less than $2.50 | 0.1% | $3.26 to $3.50 | 16.3% |
| $2.51 to $2.75 | 0.6% | $3.51 to $3.75 | 13.2% |
| $2.76 to $3 | 23.4% | $3.76 to $4 | 7.6% |
| $3.01 to $3.25 | 20.0% | Over $4.01 | 18.8% |

The lowest average rate paid at any one mine of the group during June was $3.34 per day, and the highest $3.897.

**Strike Situation Remains Unchanged** on the Mesabi Range. No mines were started up during the last week and the men who are now holding out seem determined to remain away from work until some agreement is made with the companies. However, this will not take place as long as the Industrial Workers of the World are looking after the interests of the men. The two Federal investigators are going ahead with their work and have been in attendance at most of the meetings that the strikers have held during the last week. There was some picketing by women the early part of the week and the officers did not interfere with them until one deputy was severely wounded by being struck on the head by a rock, after which the sheriff issued orders to stop picketing by both men and women. Since that time there has not been a disturbance on the range. One of the mining companies that was hit hard by having almost every one of its mines closed down has been compelled to enter the open market to get enough ore to keep its furnaces going. This company owns mostly underground properties; few underground mines east of Keewatin are operating. Shipments, however, are being maintained at a steady rate. There was some talk that the boat men were going on a strike, but the vessel owners took quick action in Detroit and granted an increase in pay of $10 a month to all men not licensed officers; the officers get their increases in the form of bonuses at the close of the shipping season. Although the I. W. W. has made attempts to start trouble on some of the other iron ranges, their efforts have been without results and it is not believed that they can accomplish anything. Wages are higher than they have been in years, in spite of the statements of the I. W. W. leaders to the contrary. The I. W. W. has no funds to support the strike and it is surprising that the miners are holding out when they are not receiving the strike benefits promised them. The Federal report on strike conditions, as made by Investigator George P. West, to the Committee on Industrial Relations, has come in for much criticism on the part of local and state authorities. The report was made public at Washington on Aug. 2, and anti-administration papers claim it to be largely political clap-trap.

### TORONTO—Aug. 5

**The Nickel Controversy** seems in a fair way of being settled by the incorporation of a new company, known as the International Nickel Co. of Canada, which will have a capital of $5,000,000. This company will build a refinery at Port Colborne, on Lake Erie, in Ontario. It will be built in units and is expected to have a capacity sufficient to supply the needs of the British Empire. The cost of the new works is put at about $4,000,000. A number of towns in northern Ontario made strenuous efforts to have the refinery placed in their localities, but the present site was decided upon on account of the proximity to the market for raw materials, the greater part of which have to be imported from the States. It requires about four tons of raw materials to refine one ton of nickel matte.

**Destructive Forest Fires,** the worst in the history of the country, occurred during the last week in northern Ontario. It will be impossible for some time to come to estimate correctly the loss of lives, but it is believed that up to the present the loss will be over 400. From Raynor to Monteith there is not a settlement left along the railroad and from Monteith to Porquois Junction the same conditions prevail. The fire was so intense that absolutely nothing is left and the sight of the blackened and devastated country is depressing in the extreme. The largest number of fatalities was around Matheson, where there is a considerable number of farmers, but in the mining section of Munro, which is a few miles from Matheson, the loss was also heavy. There is nothing left of the surface plant of the Croesus mine and several of the miners perished, but the exact number is not yet known. A number of prospectors were in the bush around this district and some of these are supposed to have perished. At the Croesus before the mine was abandoned about $75,000 in ore and bullion was put down the shaft and a short time after this the shaft timbers caught on fire. The Alexo nickel mine was completely surrounded by fires, but fortunately they did not approach the mine. At one time it was thought that the Porcupine camp might go too, and the danger was considered sufficiently real, that in some of the mines the men were brought up from underground in order that they might escape. Contrary to what might ordinarily be thought, a mine is an extremely unsafe place to be in a forest fire of the kind that visited the country this week and in 1911. The fire draws all the oxygen out of the workings and the poor unfortunates are left to smother. Fortunately a change in the direction of the wind saved parts of Porcupine this week. All the danger, to this as well as other parts of the country, is not yet over. A heavy rain last Sunday dampened but did not entirely put out the fires, and since then the warm dry weather has continued. Around about one can see the ominous smoke haze, but it is generally believed that the danger is largely over—for this time. Prospectors are already going into the burned areas where the fire has helped to expose the rocks, and it is possible that new mineral discoveries may help with the resettlement of the country which has received a great setback.

# The Mining News

### ALASKA

P. F. CUMMINGS of Seward is installing hydraulicking plant at placer properties on Bear Creek, at northern end of Kenai Peninsula. Formerly operated by Herron, Cassidy & Sullivan.

KENAI ALASKA GOLD (Seward)—James Drennan and associates, lessees, are operating 5-stamp mill on Falls Creek, 26 mi. north, on ore taken out during winter.

ALASKA GASTINEAU (Juneau)—Milled in July 150,403 tons; heads, $1.24; tails, $0.24; extraction, 80.64%, mill closed July 4 and 5. June results were: 164,800 tons milled; heads, $1.06; tails, $0.22; extraction, 79.25%.

### ARIZONA

#### Cochise County

SHATTUCK-ARIZONA (Bisbee)—July copper production 1,397,445 lb.; seven months 10,277,009 lb.

#### Gila County

FIRE IN MEXICAN CANON, MIAMI, July 26, destroyed most of Mexican part of town.

MIAMI (Miami)—July production 4,305,000 lb. copper.

INSPIRATION CONSOLIDATED (Miami)—July production 11,300,000 lb. copper, about 800,000 lb. more than in June.

VAN DYKE COPPER (Miami)—New organization of L. D. Van Dyke, Edwin Tuft and C. B. Loomis, all of Miami. Capitalization $5,000,000; shares 50c. each.

OLD DOMINION (Globe)—Hoisting 1,100 tons daily; mine now making only 6,000,000 gal. water as compared with 11,000,000 last winter; spare centrifugal pump being added.

#### Greenlee County

SHANNON (Clifton)—July production about 968,000 lb.

GOLD BUTTE MINING (Duncan)—Supersedes Twin Peaks Mining Co.; machinery on ground for mill; 1,500 tons ore on dump.

#### Maricopa County

DRAGON MINING AND DEVELOPMENT (Wickenburg)—This gold-silver-vanadium property, on western slope of San Domingo Peak, is being equipped with gasoline hoist, air drills, etc., to sink on 42-in. vein opened at 100 ft. from surface. J. F. Newman, superintendent.

#### Mohave County

OATMAN GOLD (Oatman)—Reports $8 ore in west drift, 500 level.

AOTMAN PIONEER (Oatman)—On 200 level, following a 2-ft. vein of high-grade ore.

OATMAN CRESCENT (Oatman)—In July, drove adit 281 ft. at cost of $11.12 per ft.; face now nearing objective, adit being in a total distance of 425 ft.

#### Pima County

MINE EXPERIMENT STATION will be established at Tuscon by U. S. Bureau of Mines in connection with the University of Arizona.

GOULD (Tucson)—Trustees for defunct Pioneer Smelting Co. will auction 10 unpatented claims comprising Gould mine, 18 mi. west Tucson, Aug. 10; has well equipped 360-ft. main shaft.

SWEET BYE-AND-BYE (Helvetia)—This copper group is being operated by W. B. Akers, late of Pachuca, Mexico, and Robert Farmer, of Tucson. Two to three cars shipped each week to El Paso smeltery.

NEW CORNELIA (Ajo)—Employing 750 men; carpenter shop, machine shop, warehouse, electric plant, tank house and foundations for tanks completed; work progressing on 10,000-ton coarse-crushing storage plant, power plant and smoke stack; solution storage one-third completed; 10 Mexican and 8 American houses in process of erection.

#### Yavapai County

BIG LEDGE DEVELOPMENT (Mayer) — Purchased old Treadwell smeltery and will treat ores from Henrietta, Butternut, Gopher and Hackberry mines.

HULL COPPER (Jerome)—Stockholders filed suit asking receivership and return of 5,000,000 shares of stock to treasury, following sale to United Verde by George W. Hull, of his holdings.

UNITED ARIZONA COPPER (Jerome)—President Charles Dunlap and other officers recently visited this property, 32 mi. southeast of Jerome; will continue sinking, and crosscut at 200- and 600-ft. levels.

DUNDEE-ARIZONA (Jerome)—Heavy hoist, compressor and other equipment ordered; electricity will take place of gasoline. Station at 300-ft. level finished; west drift at 65-ft. point in 25 ft. carbonate ore.

GRAND ISLAND MINING (Jerome)—Reorganized by James M. Layman and other local business men, who put 20% of their stock in the treasury and pooled the rest; contains 13 unpatented claims adjoining the Copper Chief and Shea; working shaft 200 ft. deep.

#### Yuma County

DESERT (Wenden)—Sulphide ore struck on 250-ft. level; hoist and compressor being installed.

BLACK REEF (Wenden)—New headframe and hoist being installed; freight truck purchased; shaft down 130 ft. is in ore.

COBRITA MINES CO. (Salome)—New organization of the Greggs, Los Angeles promoters, acquired this property from Arthur Neil.

MARIQUETTA (Plomosa)—Lloyd L. Miller, of Los Angeles, as heir of Julia Traves, has secured annulment of sale of mine to Benjamin Goodrich by administrator of the estate.

### CALIFORNIA

#### Amador County

ALLEN COPPER (Ione)—Copper-gold ore reported in this old mine formerly owned by Alvinza Hayward; now operated by Allen Estate Co.

KEYSTONE (Sutter Creek)—Semi-annual report shows 40-stamp mill in constant operation since Jan. 1 except 2 days for repairs and cleanup, crushed 41,084 tons, yielding in bullion and concentrates after deducting smelting charges $81,366 or $1.98 per ton. Low yield reported due to development rock which necessarily went through mill. Total cost, including franchise tax and overhead expenses, about $77,000. C. R. Downs, manager.

#### Butte County

SPRINGER (Magalia)—Harry M. Thompson and associates, prospecting this old mine with steam shovel, will exercise option. Have also bonded the Eureka mine, adjoining Mineral Slide and Lucky John mines.

LUCKY JOHN (Paradise)—Has reached channel through the 1,000-ft. adit and a 96-ft. raise; will commence washing gravel soon. Adit cut three quartz veins that warrant prospecting. John D. Hubbard, manager.

BIG BLUE LEAD (Oroville)—This gravel property near Bangor reported sold to F. F. Ford and C. G. Fowler, of San Francisco and Alaska who will expend $20,000 in development when water is available in the autumn. Former development includes 2,500-ft. tunnel.

MINERAL SLIDE (Magalia)—This old drift mine has been bonded by John Cowan and associates of Salt Lake City, Utah. A 1,500-ft. tunnel will be run on a sluice grade and it is expected that low-grade gravel left by former operators, can be worked at a profit. Mucking machines will be used. C. E. Hand, of Los Angeles, will be engineer in charge.

#### Eldorado County

BADGER HILL (Placerville)—The 300-ft. tunnel to be advanced to 650-ft. point, to form connection with main shaft.

WAGNER (Placerville)—Good ore reported at depth of 60 ft. Shaft will be deepened. A 4-stamp mill, compressor and gas engine installed.

GEORGIA SLIDE (Georgetown)—Development in progress, some ore being produced and mine may again come into regular producing class. Under management of Robert Cranston, of San Francisco, on a purchase bond.

#### Humboldt County

HUMBOLDT COPPER MINING CO. (Eureka)—Exploring with drills to develop ore of better grade than that previously opened. W. L. Perrott, secretary.

#### Mono County

CLIFF (Oasis)—This old silver group in White Mountains optioned by E. J. King and J. C. King, of San Francisco. Good road will be constructed and ore will be hauled by motor trucks to Coaldale, Nev., about 75 mi. from the mine. Reduction plant will be built if development warrants.

#### Placer County

GLOBE MINING (Auburn) — This company in Ophir district has leased following claims: Mowitza, Good Friday, Green, Enterprise, West Friday and Cornucopia. Sinking on the Mowitza (Old Copper Point) is in progress. At 300-ft. point will crosscut to the Friday. Electric-power line installed; also air compressor, machine drills and Cameron pumps.

#### San Bernardino County

OSDICK (Atolia)—"Highgraders" robbed ore bins of about 1,000 lb. of high-grade ore on July 20. First big steal of tungsten in several months.

#### Shasta County

ORO FINO (Redding)—High-grade ore disclosed by Peter Sorensen who is working this property for Charles H. Behrens.

GOLD DREDGE owned by L. Gardella at Lincoln, Placer County, will be removed to Clear Creek within the year, after having worked out its present ground. Additional dredges may be erected.

#### Sierra County

SHADY FLAT (Downieville)—Bonded to Thomas Wilson, of Manhattan, Calif. Engine and pump being installed. Two shifts sinking shaft in back channel.

MONITOR (Gibsonville)—Bonded to Monitor Mining Co. Contains extension of Bellevue channel. Drain tunnel being run to unwater 125-ft. shaft now in rich gravel.

BALD MOUNTAIN (Forest City)—Bonded to Copeland & Alling. New tunnel being run to prospect quartz vein encountered during drift operations many years ago. Perry Bixby in charge.

#### Trinity County

VALDOR DREDGING CO. (437 Holbrook Bldg., San Francisco)—The new 7-cu.ft. dredge being erected near Junction City is expected to be ready in September.

GLOBE (Dedrick)—Reported that title has reverted to original owner H. M. Hall. Company took mine four years ago, installed 20-stamp mill and cyanide plant. Not sufficiently profitable.

SIXTYFIVE (Ruth)—This placer mine on Trinity River sold to Frederick Hosking, of Placerville. Has been worked by hand methods. New owner will install 12-in. pipe line and No. 2 giant.

**Yuba County**

SOLANO WONDER (Brownsville)—Modern 10-stamp mill and cyanide plant completed. Developing underground with 16 men.

## COLORADO

**Boulder County**

BOULDER COUNTY (Cardinal)—Preparing to reopen this mine.

LIVINGSTONE (Boulder)—High-grade gold ore opened in Nyanza winze.

GILLAND (Nederland)—Lessees have opened body of high-grade tungsten ore; shipments will begin at once.

PACKARD (Boulder)—Gold quartz vein, 2 ft. wide, opened in this Beaver Creek mine. Other gold discoveries made in search for tungsten ores, are reported from west of Nederland.

**Custer County**

BASSICK (Westcliffe)—This old mine near Querida may be reopened.

BUFFALO HUNTER (Westcliffe)—Lessees opened ore assaying 20 to 30 oz. silver in old workings. Much milling ore developed.

**Gilpin County**

FRANKLIN (Rollinsville)—This 100-ton tungsten mill has started.

AMERICAN METALS CO. (Blackhawk)—Plant No. 1 started; zinc-lead ore being concentrated.

**Lake County**

ALLEGHENY (Leadville)—Retimbering will be followed by extensive development.

WOLFTONE (Leadville)—Shaft drained to 980-ft. level. McCormick and Greenback mines, connecting, are also drained.

TARSUS (Leadville)—M. A. Nicholson and J. P. Hepburn reopening this old mine on Yankee Hill struck vein of silver-copper ore.

IBEX (Leadville)—The Little Jonny continues to furnish "jewelry ore." In sampling 1-ton lot from Connors lease, the coarse screens caught 112.5 oz. of nugget gold.

HARVARD (Leadville)—New 1,200-cu.ft. compressor will be installed; also 500-gal. station pump at shaft sump. Shaft sinking will not be resumed until water problem has been completely solved.

GAMBETTA (Leadville)—Being developed through Pousardin shaft. Body of galena discovered after lower levels were drained. High-grade zinc-carbonate shipments being made from upper levels.

**Ouray County**

PLACER MINING NEAR RIDGWAY started. Work done on small scale with good results. Larger sluice will be installed.

ROCK OF AGES (Ouray)—Lessees opening good-grade copper ore.

WANAKAH (Ouray)—Development resumed; 30 or 40 men employed. Smelting plant below town expected to be "blown in" soon by Ouray Smelting and Refining Co.

SOUTH DAKOTA (Ironton)—Surface buildings completed; machinery enroute. Development to begin soon. Power line being built from Gladstone.

**Summit County**

MOZART (Montezuma)—Mill will be put in operation in near future.

PHILADELPHIA MINES (Montezuma)—Toledo tunnel equipped with large air compressor. Auto trucks hauling 50 tons daily from Jumbo mine to mill.

COLORADO ORE SEPARATING CO. (Breckenridge)—Smith 500-ton mill purchased recently; contracts being made for low-grade ore that cannot be sold for shipment.

FRENCH GULCH DREDGING CO. (Breckenridge)—Shipment of $15,000 in gold from 10-days' run made recently to Denver mint. Dredge handles 2,100 cu.yd. per 24 hr.; pay streak now 400 ft. wide.

DUNKIN (Breckenridge)—Shipment assaying 40% lead, 18 to 25 oz. silver and considerable gold, made recently. Free gold in this ore is coarse, sometimes in large flakes and crystals. Mine operated by lessees.

MONTEZUMA MINES (Montezuma)—Regular shipments to milling plant made from Silver Wave, Chautauqua and Princess mines; treating by flotation 65 tons per day. Site for new mill at base of Teller Mountain cleared. All mines will be connected to plant by aërial trams.

**Teller County**

MARGIE M. GOLDING MINING CO. (Cripple Creek)—Organized to operate Little Daisy mine on Bull Hill.

VINDICATOR CONSOLIDATED (Cripple Creek)—During second quarter, development of middle vein system carried on. Oreshoot of better than average grade opened between 12th and 18th levels. Flotation plant below Golden Cycle ore house will be completed Sept. 1. Results of flotation work may make change in policy of handling low-grade ore now used for stope filling.

## IDAHO

**Idaho County**

CONCORD GOLD CORPORATION (Elk City)—This company recently formed by Edward Everett Rowe and others of Salt Lake to develop 380 acres. About 1,500 ft. of tunnel development. Frank Steckner in charge.

## MICHIGAN

**Iron**

MUNRO (Iron River)—Property is to be stripped. Contract awarded to Hoose & Person. Pit will be 500 ft. long by 175 ft. wide.

CLEVELAND-CLIFFS (Ishpeming)—Contracts have been awarded for a change house at the Holmes and a new office at the Cliffs mine.

MARY CHARLOTTE (Negaunee)—Two shifts now being worked instead of three. Same force of men employed. One of the last Lake Superior mines to change from the old eight-hour system to two eight-hour shifts.

OLIVER (Ironwood)—All of this company's mines on the Gogebic range are to be electrified. An order for 10 electric hoists was given to Wellman-Seaver-Morgan Co. Sullivan Machinery Co. will build two large compressors and supply motors for same. General Electric Co. awarded contract for motors for the hoists, generators and a large turbine. These orders will amount to over $400,000.

## MINNESOTA

**Cuyuna Range**

CUYUNA RANGE TONNAGES with 16 shipping mines now operating, are expected this season to amount to 1,700,000 tons of iron ore and 300,000 tons of manganiferous material.

HOCH (Manganese)—Will ship upward of 35,000 tons of manganiferous iron ore this season.

ROWE (Riverton)—Stated that Pittsburgh Steel Ore Co. will add another unit to the 500-ton concentrating plant at this mine. Mine will ship 300,000 to 400,000 tons this season.

**Vermilion Range**

SAVOY (Ely)—In two weeks the last ore from this property will be extracted by the Oliver company, lessee, and the mine will then be abandoned. Property has for many years been one of the principal producers of the Vermilion Range.

## MISSOURI-ARKANSAS

**Joplin District**

BONNIE BELLE (Joplin)—Has broken into rich ore in new shaft.

FIGHTING WOLF (Zincite)—Operations resumed after several months shutdown on account of excessive water.

ETTA MAY (Joplin)—New mill to be operated steadily as soon as ground is better opened. Face approximately 45 ft. in height.

AURORA UNION (Aurora)—Sinking shaft from 200- to 300-ft. level. Deep for Aurora camp but drills blocked out good ore at this depth.

BETSY JANE (Zincite)—New mill near completion on lease of Brooks land. Will work disseminated formation at 110 ft. Two shafts opened.

KING JACK (Commerce)—Lost compressor and two boilers in cave-in. Bessemer gas engine saved by cables. Mine owned by Commerce Mining and Royalty Co.

GRAY (Webb City)—New 500-ton mill well underway on tract adjoining D. C. & E. mine, in Oronogo bottoms, north of Webb City; Philip Gray and Eastern associates, owners.

ST. REGIS (Duenweg)—Completed Number 2 mill at Chitwood; capacity 300 tons per shift. Mining disseminated formation at 180 ft.; sheet-ground formation underneath, which will be worked later.

**Northern Arkansas**

MANY PRODUCERS in this field holding their ore, but shipments for month of July amounted to 75 cars. Of this number, 30 came from Rush, 15 from the upper and lower Buffalo camps, 18 from Searcy and Newton Counties, and 7 from Zinc.

## MONTANA

**Beaverhead County**

BOSTON & MONTANA DEVELOPMENT CO. (35 Congress St., Boston, Mass.)—To facilitate shipments from company's Spain mines, in French Gulch, to Washoe smeltery, a spur is being built from B. A. & P. tracks at Mill Creek near the smeltery to a loading station to which motor trucks will bring ore from mines 12 mi. The trucks will haul four trailers carrying 4 tons each. Similar haulage is to be carried on from the company's Elkhorn mines at the head of Wise River in Jefferson County.

**Silver Bow County**

ANACONDA (Butte)—Cave-in, Aug. 4 at Tramway mine, 2,000-ft. level, extended upward 150 ft.; one man killed.

BUTTE-BALLAKLAVA (Butte)—Developing orebodies on 2,600 level; drifted 75 ft. on vein. About 100 tons of 3% ore being hoisted daily.

EAST BUTTE EXTENSION (Butte)—Company's Westlake and Rose O'Malley mines being successfully worked under lease. Recently shipped 58 tons of $27 ore from the Westlake. Company receives 25% royalty on proceeds of operations.

BUTTE-DETROIT (Butte)—Operating old Ophir mine in southern part of district; preparing mill for resumption and arranging for sinking 1,000-ft. shaft to 2,000 ft. Zinc ores previously encountered on 500 level were not given attention at the time, as there was no market for them.

NORTH BUTTE (Butte)—During quarter ended June 30, shipped 146,190 wet tons of ore, as against 131,070 tons in first quarter. Principal new ore development during quarter was opening of North Berlin vein north of present workings and cutting of vein below the 3,500 level in Granite Mountain shaft, 500 ft. below present deepest workings.

BUTTE & SUPERIOR (Butte)—July production showed slight falling off from that of June. Total ore hoisted was 51,710 tons from which 14,005 tons of zinc concentrates were secured. Concentrates averaged 53.53 per cent. zinc or about 15,000,000 lb. New main shaft is completed and timbered to 1,500-ft. level. Will be carried to 1,900 level later.

## NEVADA

### Elko County

OIL-SHALE BEDS about 1 mi. south of Elko are being actively developed. R. M. Catlin, of New York, Franklin Furnace, N. J., is interested and a 20-ton experimental plant is to be erected.

NORTH STAR (Jarbidge)—This mine and mill purchased by John Creighton.

LONG HIKE (Jarbidge)—John E. Newsom and others engaged in making examination of this mine.

SEATTLE-CONTACT COPPER (Contact) — Working 40 men at the Delano mine. Shipping to Garfield, Utah, 400 to 500 tons of 11% ore monthly. Lower grade ore being stockpiled.

### Esmeralda County

FLORENCE (Goldfield) — Additional crushing and other equipment placed and plant now running at increased capacity.

GREAT BEND (Goldfield)—Connections made with old lease workings on the 235-ft. level. East drift being run on 6-ft. vein showing seams of excellent ore on both walls.

SPEARHEAD (Goldfield)—Company reorganized on assessable basis. Two shifts working and shaft is down about 740 ft. with latite-shale contact as objective. Drifting in progress on the 400 level.

LOS ANGELES SULPHUR CO. (Goldfield)—Erecting camp buildings and will work sulphur deposits at Cuprite about 13 mi. south of Goldfield. Initial shipments show about 75% sulphur. Company has contracts for 250 tons per month. A. W. L. Dunn, manager.

GOLDFIELD CONSOLIDATED (Goldfield)—In June treated 29,000 tons; net yield, $40,459. Operating costs, $5.22 per ton; miscellaneous earnings, 11c.; net operating cost, $5.11 per ton. On June 20, half of mill was converted to flotation process and second section expected to be converted by Aug. 15. July estimate, treated 30,000 tons, net yield $30,000.

### Humboldt County

SEVEN TROUGHS COALITION (Seven Troughs) — Bird winze down 1,725 on dip of vein. The north drift on the 1,700 has encountered the oreshoot which is being stoped on the level above. High assays reported.

### Nye County

TONOPAH ORE PRODUCTION for week ended July 29 was 9,217 tons valued at $191,986 compared with 10,139 tons for week previous. Producers were: Tonopah Belmont, 2,951 tons; Tonopah Extension, 2,200; Tonopah Mining, 1,650; Jim Butler, 1,150; West End, 895; Rescue-Eula, 205; Halifax, 158; miscellaneous, 8 tons.

NORTH STAR (Tonopah)—Development continues on 850-ft., 900-ft. and 1,050-ft. levels. Occasional shipments made to West End mill.

TONOPAH MINING (Tonopah)—In quarter ended May 31 net income was $118,012; of this amount $32,845 was from Tonopah Placers Co.

TONOPAH EXTENSION (Tonopah)—June profit $51,726 from 8,966 dry tons milled yielding $125,471; bullion production 1,481.48 oz. gold and 156,154 oz. silver. Repairs to Victor shaft and workings completed; development on 1,540-ft. level again under way.

### Washoe County

A MINE-RESCUE CAR of U. S. Bureau of Mines will be stationed at Reno, Nev.

### White Pine County

NEVADA CONSOLIDATED (McGill)—June production, 8,651,772 lb. copper.

## NEW MEXICO

### Socorro County

PROPOSED ROAD from Clifton, Ariz., to Mogollon again receiving consideration. It is understood the Arizona factors will construct highway to state line; Mogollon interests now running survey from the Silver City road at Cactus Flats to determine feasibility of route. Distance to railroad would be shortened 20 mi., with reduction of $5 per ton in freight charges.

## UTAH

### Beaver County

MOSCOW (Milford)—During June 300 tons of 9% copper ore were shipped. Zinc-carbonate ore recently developed along footwall of old lead stopes, from the surface down to the 800 level. Shipments from this ore will soon be started.

CROFF (Milford)—Eight feet of ore carrying lead, silver, and zinc has been cut at a depth of 155 ft. in the Lincoln district.

CEDAR-TALISMAN (Milford)—Plans are under consideration for milling of the zinc-lead ores. Dump contains 6,000 tons. A dry process similar to that used at Goodsprings, Nev., may be used. Shipments of lead ore and zinc ore being made. H. S. Josephs, manager.

### Grand County

OIL-LAND LOCATIONS recently recorded at Moab. Claims are between Valley City and Green River. Filings made by Eastern operators.

### Juab County

TINTIC SHIPMENTS for July amounted to 679 cars by 35 shippers. Chief Consolidated and Dragon Consolidated shipped the largest tonnage.

EAGLE & BLUE BELL (Eureka)—New strike in main shaft opened for 28 ft., between 1,832 and 1,860-ft. points. Not known yet whether orebody is a new one or continuation of those already opened above. The ore appears to be pitching to the west.

LOWER MAMMOTH (Mammoth)—A 25-ton leaching plant is to be built to treat the 12 to 15% zinc ore developed some time ago. Leaching with sulphuric acid and precipitation electrolytically will be done, as outlined by experiments carried on by Pierre Peugot of Western Spelter Co. of Salt Lake City.

### Salt Lake County

MUCH ACTIVITY IN ALTA; prospecting and development is being done at many properties. Shipments averaging four cars a day or over. The South Hecla, Michigan-Utah, Albion, Alta Consolidated, Sells, Wasatch Mines, and others are shipping.

SOUTH HECLA (Alta)—Shipping 350 to 375 tons of ore weekly.

MICHIGAN-UTAH (Alta)—Up to three cars of ore in one day have been sent over this company's tramway to Tanner's Flat, from where ore is hauled by team to the railroad at Wasatch.

UTAH METAL AND TUNNEL (Bingham)—Suit was filed Aug. 2 against J. H. Anderson, receiver for the New England Gold and Copper Co. to quiet title to certain claims in the West Mountain Mining district. Pending trial injunction asked against operating the claims.

### Summit County

PARK CITY SHIPMENTS for July amounted to 7,780 tons by 11 shippers. In June 8,714 tons of crude ore and concentrates were produced.

DALY (Park City)—Early in August ore will be raised through shaft instead of being sent out through Ontario drain tunnel. Expect to install new hoisting engine and use both compartments of shaft.

BIG FOUR EXPLORATION (Park City)—Operations started Aug. 2 at mill, which has been enlarged to treat 750 tons of tailings daily. Zinc concentrates, and lead-iron concentrates are produced. Flotation equipment to handle 75 tons per day has been added. Tailings accumulated below Park City for a number of years are to be handled by a steam shovel.

## WEST VIRGINIA

UNITED ZINC SMELTING CORPORATION (Moundsville) —Has begun erection of its new zinc smelting plant here instead of at Clarksburg, as first contemplated. F. J. Eckenfels, engineer in charge.

## WISCONSIN

### Zinc-Lead District

CLIMAX (Platteville)—A new M. M. type Dings magnetic separator installed. Company will engage in custom roasting.

WISCONSIN ZINC (Platteville)—New 150-ton Birkbeck mill at Days Siding in operation; jig concentrates assay 52% zinc.

VINEGAR HILL (Platteville)—New Graham property at Days Siding gives promise of being best of this company's seven producers.

M. & A. (Platteville)—New 100-ton mill at Rewey completed; mine being unwatered; electric power supplied by Mineral Point Service Co.

HEFFERNAN (Platteville)—Kistler & Stephens have proved another range of zinc ore in drilling this lease west of their Blockhouse property.

## CANADA

### British Columbia

MOLYDENUM MINING AND REDUCTION (Alice Arm)—This company, which has a government contract, has completed its 100-ton flotation plant on Alice Arm, about 14 mi. from Anyox.

### Ontario

FOLEY O'BRIEN (Porcupine)—Expected to resume operations shortly.

CONIAGAS (Cobalt)—Will install 100-ton flotation plant to treat mill slimes.

DOME EXTENSION (Porcupine)—Work in shaft and lateral development discontinued. Orebodies discovered by diamond drill at greater depth considered more worthy of further exploration than the showing on the upper levels.

CANADIAN COPPER (Copper Cliff)—New steel headframe and rockhouse at Creighton mine are nearing completion; shaft will be concreted. At Copper Cliff, fine new recreation club has been finished; nominal fee charged; employees' wives have privileges of club certain days.

MURRAY (Sudbury)—This mine being unwatered and it is expected that operation will follow. George Johns, formerly of Dome mines, is in charge. Activity assumed to be connected with proposed process of Sudbury Nickel Refineries, Ltd., of Ottawa.

### QUEBEC

STRIKE OF ASBESTOS MINERS of Thetford began Aug. 3; endeavoring to extend strike to Black Lake and Robertson mines.

## MEXICO

SANTA GERTRUDIS (Pachuca, Hidalgo)—In June, milled 19,775 dry short tons yielding £32,017; working expenses £28,583; operating profit £3,434. May profit £15,000. Policy of future to treat lower grade ore than milled during last few months. Profits affected by higher labor cost, increased taxation and timber shortage.

## CHINA

JAPANESE INTERESTS, represented by the Sino-Japanese Development Co., have, according to the "Far East Review," secured the rights to work the Taochung iron mine at Taochung, Fanchang-Hsien, Anhui Province, China. Mine is said to contain 60,000,000 tons of 65% ore.

## CHOSEN

ORIENTAL CONSOLIDATED (Unsan)—July cleanup, by cable, $128,750. Final figures for June were: Milled 26,511 tons; Tabowie mill bullion, $27,321; Taracol, $22,651; Maibong, $24,688; Taracol cyanide bullion, $47,877; Maibong tube-mill bullion, $6,067; total, $128,605.

# The Market Report

## Metal Markets

**NEW YORK—Aug. 9**

There was a further improvement in copper on increasing business, although the total did not attain large proportions. A good business was done in both lead and spelter, but at a further sacrifice of prices.

## Copper, Tin, Lead and Zinc

**Copper**—This market exhibited some curious features, one producer reporting no transactions, other reporting transactions on certain days, and others reporting good business right through the week. The principal producers are now in the market and are taking business on the present level of prices, although most of them are not courting business, so confident are they in the strength of the statistical position and the belief that buyers will have to come to the producers rather than will the producers have to hunt buyers. The business reported for the week was chiefly with domestic consumers, but they were consumers engaged in the manufacture of ammunition rather than of wares for peaceful purposes. The bulk of the business was for October-November delivery, for which some large transactions were made at 25½c., r.t., or about 25¼c., cash, New York. Toward the close the market was a shade higher. Our quotation for Aug. 5 reflects some special transactions on that day.

Joseph Clendenin, of the American Smelting and Refining Co., said in an interview a few days ago: "The drive at the market in July was opportunely timed. The large American consumers could not work to capacity on account of the heat, labor shortage and scarcity of crucibles for melting brass. This same condition will prevail through August and into September. As a consequence a good deal of copper was thrown on a narrow market and forced the price down to an unnatural level. Some consumers thought it was more in the line of good business to ask the producers to carry forward their engagements. The producers were glad to accommodate their customers and many millions of pounds were transferred from summer to fall delivery."

**Copper Sheets** rule on a base of 35½ to 37½c.

**Copper Exports** from Atlantic ports in July are estimated at 32,500 gross tons.

**Copper Exports** from Baltimore for the week included 4,759,630 lb. to Great Britain; 3,951,026 lb. to France; 88,873 lb. to Rotterdam; 208 tons brass to Italy.

**Visible Stocks of Copper** in Europe Aug. 1 were: Great Britain, 3,440; France, 2,525; afloat from Chile, 2,175; afloat from Australia, 3,500; total, 11,640 gross tons, or 26,073,600 lb. This is a decrease of 1,174 tons from the July 15 report.

**Tin**—In the early part of the week this market was dull, but subsequent to Monday a good demand developed and there was a general improvement in business.

**Visible Stocks of Tin** on Aug. 1, including tin afloat: London, 7,999; Holland (Banka), 1,460; United States, excluding Pacific ports; 8,945; total, 18,404 gross tons. This is a decrease of 959 tons from July 1, but an increase of 4,237 tons over Aug. 1 last year.

**Banka Tin Production** for the six months ended June 30, 1916, is reported at 5,793 gross tons. Shipments for the same period were 11,863 tons, large stocks held in the East having been transferred to Holland. Stocks held on June 30 by the Netherlands Trading Co. were 760 tons; by the Dutch Government, 3,388 tons, the latter including 1,023 tons afloat. The Banka production was less than in the second half of 1915 by 1,900 tons.

Imports of tin ore and concentrates in Great Britain in June were: Bolivia, 1,353; Nigeria, 611; British India, 114; Portugal, 88; Spain, 24; France, 13; Natal, 13; Brazil, 9; total, 2,223 gross tons, equivalent to about 1,334 tons tin.

**Lead**—Following the reduction to 6c. by the A. S. & R. Co. on Aug. 2, business was done at that price on Aug. 3, but price cutting on competition of the kind that had previously been experienced began again. In the early part of this calendar week some large business was done at 5.90c., New York, but offers of round lots at the same price on the same day failed to find buyers. Fairly large business was booked by certain producers while others consummated scarcely anything. At the close the St. Louis market appeared to be a shade stronger.

**Spelter**—Right from the beginning of the week there was real pressure to sell. On Friday tonnages were sold at 7¾ @ 8c., August-September delivery. Some large business was done on Aug. 8 at the same price. There were sellers right through the week at that price. Sales at lower figures were reported

DAILY PRICES OF METALS IN NEW YORK

| Aug. | Sterling Exchange | Silver, Cts. per Oz. | Copper | Tin | Lead | | Zinc |
|---|---|---|---|---|---|---|---|
| | | | Electrolytic, Cts. per Lb. | Spot, Cts. per Lb. | New York, Cts. per Lb. | St. Louis, Cts. per Lb. | St. Louis, Cts. per Lb. |
| 3 | 4.7581 | 64¼ | 25<br>@25½ | 38 | 6.00<br>5.90 | 5.75<br>@5.85<br>5.70 | 7.75<br>@8.25<br>7.75 |
| 4 | 4.7588 | 64¼ | 25<br>@25½ | 37¾ | 6.00 | @5.80 | @8.00 |
| 5 | 4.7581 | 66¼ | 25½<br>@26¼ | 37¾ | 5.85<br>@5.95 | 5.65<br>@5.75 | 7.75<br>@8.00 |
| 7 | 4.7588 | 65¾ | 25½<br>@25¾ | 37¾ | 5.85<br>@5.90 | 5.65<br>@5.75 | 7.75<br>@8.00 |
| 8 | 4.7588 | 66¼ | 25½<br>@25¾ | 37¾ | 5.85<br>@5.90 | 5.65<br>@5.75 | 7.75 |
| 9 | 4.7588 | 66¼ | 25½<br>@25¾ | 38 | 5.85<br>@5.90 | 5.70<br>@5.75 | 7.75<br>@8.00 |

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" (r.t.) is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are as reported by Handy & Harman and are in cents per troy ounce of silver bars 999 fine.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

| Aug. | Silver | Copper | | | | Tin | | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Standard | | Electrolytic | | | | | | | |
| | | Spot | 3 Mos. | £ per Ton | Cts. per Lb. | Spot | 3 Mos. | £ per Ton | Cts. per Lb. | £ per Ton | Cts. per Lb. |
| 3 | 30⅞ | 107 | 104 | 125 | 26.61 | 168 | 168¾ | 28½ | 6.07 | 47 | 10.01 |
| 4 | 30⅛ | 106 | 103 | 125 | 26.61 | 167½ | 168½ | 28½ | 6.07 | 47 | 10.01 |
| 5 | 31½ | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 7 | 31 7/16 | 106½ | 103½ | 124 | 26.40 | 167½ | 168¼ | 28¾ | 6.12 | 44 | 9.37 |
| 8 | 31⅛ | 107 | 105 | 124 | 26.40 | 167¼ | 168 | 28¾ | 6.12 | 44 | 9.37 |
| 9 | 31⅛ | 109 | 106½ | 124 | 26.40 | 168 | 169 | 29 | 6.17 | 47 | 10.01 |

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅓c.

as actually made, but there were probably some special conditions in connection with them. However, such transactions reflected the weak tone of the market. The bulk of the business was reported for August-September delivery, but there was some done for October-December, at not much difference in price.

High-grade spelter at the close was quoted at 16@20c., intermediate, at 12@14c., brass special, at 9@10c. The manner in which the price for high-grade and intermediate spelters has held up in face of the weakness in common spelter is one of the mysteries of the market. The production of these classes of spelter at the present time is very large, one estimate being at the rate of 100,000 tons per annum.

The publication of the Washington statistics on Aug. 5, showing that the stock in the hands of smelters on July 1 was about 24,000 tons, an increase of 10,000 tons from the beginning of the year, had apparently been discounted by the market.

Butte & Superior has purchased from Hayden, Stone & Co. 35,000 shares of the common stock of the American Zinc, Lead and Smelting Co.

The United Zinc Smelting Corporation is to build its new plant at Moundville, near Wheeling, W. Va.

Charles Hayden, Galen L. Stone and D. C. Jackling have been elected to the board of directors of the American Zinc, Lead and Smelting Co.

**Zinc Sheets** are in fair demand, both for domestic deliveries and for export. The quotations are unchanged at $15 per 100 lb. f.o.b. Peru, Ill., less 8% discount.

## Other Metals

**NEW YORK—Aug. 9**

**Aluminum**—The market is quiet and does not show much change. Trading has been moderate, and has been on a basis of about 60c. per lb. for No. 1 ingots, New York.

**Antimony**—This metal which was quoted at 12¼c. at the end of our last week, receded further under the pressure of some holders of spot metal. We quote 10¾@11c. at the close.

**Quicksilver**—This market receded further on small business. At the close we quote $75, New York. San Francisco reports, by telegraph, $76.

**Minor Metals**—Current quotations for **Bismuth** are $3.15@3.30 per lb., New York.—**Cadmium** is quoted at $1.30@1.50 per lb.—**Cerium,** electrolytic, is sold at $8@9 per lb.—**Cobalt Metal** is quoted at $1.25 per lb.—**Magnesium** is lower, with sales at $3.50@3.75 per lb. for 99% pure.—**Selenium** is from $3 up to $5 per lb., according to size of order.

## Gold, Silver and Platinum

**NEW YORK—Aug. 9**

**Gold**—A shipment of $50,000 in gold bars was received at the Assay Office in New York Aug. 4 from Shanghai for the account of the Guaranty Trust Co., coming through by registered mail from the trust company's agency in the Chinese city. The gold consisted of eight bars of exceptional fineness, each contained in a section of bamboo, with one end sealed by the joint. This was the first consignment to be received in these unusual containers in six months. The postage stamps on each bamboo section amounted to $1.80. It was said at the Assay Office that if the gold had been sent by express each package would have borne a shipping charge of close to $50. Last Autumn about $150,000 in gold arrived by mail from Shanghai in several shipments of the same sort.

**Silver**—The market has been firm and advancing this week on large purchases in London for coinage purposes for the English and French mints. China exchanges still continue under silver parity but silver stock is low and the failure of raising a loan with the U. S. may influence the silver situation.

The demand from India should increase based on favorable Monsoon reports. Market closes firm in London at 31 1/16 pence.

**Gold and Silver Movement** in the United States in May is reported by the Department of Commerce as below.

| | Gold | | Silver | |
|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 |
| Exports | $1,277,554 | $11,918,597 | $4,741,231 | $6,211,930 |
| Imports | 31,136,311 | 27,321,943 | 2,352,242 | 2,724,784 |
| Excess | I.$29,858,759 | I.$15,403,346 | E.$2,388,989 | E.$3,487,146 |

The total exports of silver for the 11 months of the fiscal year from July 1, 1915, to May 31, 1916, were valued at $55,147,214; imports, $30,971,335; leaving $24,175,879 as the excess of exports.

**Mexican Dollars** in New York were quoted on Aug. 3 at 49¼@53c.; Aug. 4 at 49¼@53c.; Aug. 5 at 49¾54c.; Aug. 7 at 49¾@54c.; on Aug. 8 at 50¾c., and on Aug. 9 at 51@55c.

**Platinum**—This market was a shade weaker. Sales were reported at $57.50@58.50, which we quote as the market.

Our Russian correspondent writes from Petrograd, under date of June 16, that the demand has increased materially and that consequently prices have advanced. A little more than 100 lb. was sold at 67,500 roubles per pood, equal to $65.98 per oz. From Ekaterinburg it is reported that production has been reduced due to mobilization among the miners. Quotations at Petrograd are about 67,750 roubles per pood, $66.39 per oz., and at Ekaterinburg 17.625 roubles per zolotnik, $65.27 per oz.

## Zinc and Lead Ore Markets

**Joplin, Mo., Aug. 5**—Quotations are as follows: Blende, high price, $72.90; per ton 60% zinc, premium ore, $70; medium, $65@50; low, $50. Calamine, per ton 40% zinc, $40@35; average selling price, all grades of zinc, $64.93 per ton.

Lead, high price, $69.80; base, $70@65 per ton 80% metal content. Average selling price, all grades of lead, $67.78 per ton. Shipments for week ended Aug. 5 were 4,550 tons blende, 232.5 tons calamine, and 1,216 tons lead ore. For year to date, 205,517 tons blende, 15,985 tons calamine and 35,790 tons lead ore. Total value, $392,960 for week and $24,590,980 for the year to date.

A further reduction of $5 per ton on blende and $10 on calamine has about forced the conclusion among producers that all hope of an improvement in prices has passed. The production has dwindled to under 5,000 tons and shipments around 4,800 to 5,200 tons per week. No new demand has arisen for ore, and with some smelters out and others quitting, there seems slight prospect for an increased demand. A general reduction of 25c. per day was made on labor for this month, based on the average price for last month, and as many mines are already idle there seems no likelihood of labor trouble from the cut in wages.

**Platteville, Wis., Aug. 5**—Quotations are as follows: Base price per 2,000 lb. for top grades was $60, ranging down to $52 per ton for medium grades. The base price paid this week for 80% lead ore was $65 to $68 per ton. Shipments for the week were 2,020 tons zinc ore, 227 tons lead ore and 239 tons sulphur ore. Year to date, 71,533 tons zinc ore, 2,645 tons lead ore and 16,580 tons sulphur ore. Shipped during the week to separating plants, 3,242 tons zinc ore.

**OTHER ORES**

**Tungsten Ore**—This market became rather demoralized during the week, certain holders of the ore making up their minds to take what they could get. As a result of this, sales were made at about $20, and we quote the market for the week at that price on the basis of transactions effected. At the close there were different views of the market. Some interests considered that the situation had been relieved and were asking $25@30 per unit. However, all sellers were not of that opinion.

**Antimony Ore**—Small quantites are reported as having been sold at $1.10@1.20 per unit.

**Manganese Ore**—Imports at Baltimore included 320 tons manganese ore.

**Manganese Deposits in Lower California** are described in a recent issue of the "Boletin Minero." These mines, which are reported to be the richest known deposits of this element in the world, are situated in the arid hills of a small peninsula, 25 mi. long and from 5 to 8 mi. wide, between the coasts of the Gulf of Lower California and Concepcion Bay. The Pilares de Gavilan mines consist of 15 claims, the outcropping veins being from 1 to 5 ft. thick, and are estimated to contain 1,733,333 tons of pure manganese. The Trinidad mines have ore veins which vary from a few inches to 16 ft. in thickness, and the Guadalupe mine has veins of this ore from 5 to 6 ft. thick. A spring of potable water exists in the vicinity of the Trinidad mines, and at Guadalupe the water stratum is from 40 to 60 ft. below the surface. Near the port of Guaymas, about 90 mi. distant, coal mines and petroleum deposits are known to exist, and in normal times provisions and other supplies are easily obtainable there, while firewood can be secured in the vicinity of the mines.

## Iron Trade Review

**NEW YORK—Aug. 9**

The iron and steel markets show little change. Demand for steel and manufactured products is strong and domestic consumption continues steady. Pig iron and light sheets are

not so active, but it is expected that there will be more buying later.

The continued hot weather maintains its influence on production, but with cooler temperatures, better production is looked for. Exports from Baltimore for the week included 997 tons of scrap rails, 1,535 tons steel bars and 1,211 tons steel billets to Italy.

**Pig Iron Production in July** was a little below the June mark, the chief cause being hot weather and slower working of furnaces, on account of the heat and slack labor. The monthly reports of the furnaces as collected and published by the "Iron Age" show that on Aug. 1 there were 319 coke and anthracite stacks in blast having a total daily capacity of 104,400 tons, or 3,400 tons less than on July 1. Making allowance for the charcoal furnaces the total make of pig iron in the United States in July was 3,261,500 gross tons; for the seven months ended July 31 it was 22,873,300 tons. Of this total 16,126,100 tons, or 70.5%, were made by the furnaces owned or operated by the steel companies.

### PITTSBURGH—Aug. 8

Following its advance of $2 a ton in steel bars reported a week ago the Carnegie Steel Co. has now made similar advances in shapes and plates, its present minimum quotations being: Bars and shapes, 2.60c.; plates, 3.00c. The independents are disposed to follow in the advance but wish first to cover regular customers on such tonnages as they will close for at once, so that prices are in a transitionary stage. Effective yesterday, the American Steel and Wire Co. advanced its prices on wire products $2 a ton and the advance was immediately followed by the independents, making plain wire 2.55c. and nails $2.60.

Thus the finished-steel market appears to have resumed the advancing tendency that practically disappeared last March. While the advances just made have some appearance of artificiality about them, seeing that they occurred when the market was far from active, they are a practical demonstration of the strength of the mill position and thus are likely to encourage buying. The tendency is to dispel the idea that the steel market had been wound up, with the amount of unfilled business on books, and that it was simply a question of how long it would take for it to run down.

To the advancing tendency in finished-steel products is added the fact that unfinished steel has grown still scarcer, and altogether the market position seems to be a very strong one, stronger than a fortnight ago, and much stronger than was expected to be developed in a dull summer.

The idea that high prices for steel products will greatly curtail consumption in certain directions has not been abandoned, but the full effect of high prices cannot be universally felt for some time to come. There is still some cheap steel being shipped, including bars and shapes at 1.15c. to 1.25c., though not as large a tonnage as formerly, and this cheap steel is helping out the consumption.

**Pig Iron**—The market continues very dull as to actual transactions and there is no large volume of inquiry, but there is somewhat more interest manifested in the market by consumers. There are occasional inquiries for foundry iron for the first half of 1917, a period upon which the furnaces are indisposed to quote. We quote prices unchanged: Bessemer, $21@21.50; basic, $18@18.25; foundry and malleable, $18.25@18.50; forge, $18@18.25, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh.

**Steel**—Billets and sheet bars are almost unobtainable for any delivery, and there is much more pressure on the part of buyers, for both nearby and forward deliveries, while there is continued inquiry for all descriptions of steel for export. The buying of shell steel has continued to date, and deliveries are now running into 1917. The production of shell steel is not decreasing, and is probably increasing. Prices are quotable higher, but are practically nominal. We quote bessemer at $45 and open-hearth at $45@46, for both billets and sheet bars. Rods are stronger, but are still quotable at $55@60.

### FERROALLOYS

**Ferrosilicon,** high grade, 50%, is quoted $84@$86 per ton, Eastern freight allowed.

**Ferromanganese**—The market continues quiet, with prompt at $175@$200, and contract at $175.

The estimated production of ferromanganese and spiegeleisen in the United States in July was 30,786 gross tons; for the seven months ended July 31 it was 215,220 tons.

### IRON ORE

Shipments from the Lake Superior region continue very heavy. Port shipments have not yet been received but the total for July is reported by telegraph at 9,750,157 gross tons; making a total for the season from the opening of navigation to Aug. 1 of 29,365,724 tons, which compare with 18,725,303 tons for the corresponding period last year.

### FOREIGN IRON

**Pig-Iron Production in Canada** for the half-year ended June 30 was as follows in gross tons, comparisons being made with both halves of 1916:

| | 1915 | | 1916 |
|---|---|---|---|
| | First Half | Second Half | First Half |
| Basic | 292,556 | 367,813 | 388,387 |
| Bessemer | 5,238 | 8,476 | 12,575 |
| Foundry | 59,646 | 66,123 | 95,602 |
| All other | 9,385 | 16,183 | 11,186 |
| Total | 366,825 | 458,595 | 507,750 |

Of the iron made in 1916 a total of 398,683 tons was for conversion into steel or other use by the makers, and 109,067 tons were merchant iron for sale. There were 12,154 tons made with charcoal and 495,596 tons with coke.

### EXPORTS AND IMPORTS

**British Imports and Exports of Metals** other than iron and steel are reported as below for the six months ended June 30, in gross tons:

| | Imports | | Exports | |
|---|---|---|---|---|
| Metals: | 1915 | 1916 | 1915 | 1916 |
| Copper | 115,806 | 72,797 | 16,931 | 15,987 |
| Tin | 24,229 | 17,762 | 22,867 | 18,652 |
| Lead | 134,723 | 87,928 | 30,692 | 18,523 |
| Zinc | 52,163 | 21,870 | 1,543 | 919 |
| Quicksilver | 792 | 942 | 151 | 443 |
| Minor metals | 2,561 | 2,270 | 9,531 | 11,072 |
| Ores, etc. | | | | |
| Tin Ore | 25,158 | 15,902 | ..... | ..... |
| Pyrites | 439,300 | 514,125 | ..... | ..... |

Copper includes contents of ore, matte and precipitate. Exports include reëxports of imported material.

### COKE

**Connellsville**—The market remains approximately even, quotations being $2.50@2.75. Foundry coke is $3.25@3.50 for prompt or contract. Demand has not been heavy but the market has seen no surplus tonnage. Labor scarcity has been an obstacle for the coke makers, the high temperatures and himidity having a bad effect.

The scarcity of spot furnace coke continues and the market is quotable at $2.75@2.85. With cooler weather production will doubtless increase.

**Imports of Coal and Coke in Chile** for the year ended Dec. 31 were, in metric tons:

| | 1913 | 1914 | 1915 |
|---|---|---|---|
| Coal | 1,540,747 | 1,257,559 | 411,317 |
| Coke | 46,337 | 46,911 | 50,151 |
| Total | 1,587,084 | 1,304,470 | 461,468 |

Of the coal imports in 1915, Great Britain furnished 201,718 tons, Australia 155,541 tons and the United States 51,375 tons. Of the coke 27,994 tons were from Great Britain and 20,172 tons from the United States.

**British Exports of Fuel** six months ended June 30 in gross tons:

| | 1915 | 1916 | Changes |
|---|---|---|---|
| Coal | 22,332,590 | 19,075,461 | D. 3,257,129 |
| Coke | 419,709 | 744,247 | I. 324,538 |
| Briquettes | 624,875 | 684,979 | I. 60,104 |
| Steamer coal | 7,400,321 | 6,578,207 | D. 822,114 |
| Total | 30,777,495 | 27,082,894 | D. 3,694,601 |

The steamer coal is coal sent abroad for use of steamships in foreign trade.

## Chemicals

### NEW YORK—Aug. 8

**Arsenic**—Dealers report continued quiet and state present movements are mostly against old contracts. Relatively little for sale on spot but dealers still quote $6.00 to $6.25 per 100 lb. according to quantity desired.

**Copper Sulphate**—The market is reported rather quiet, but there is little change in range of prices. Export demand is dull at present. Prices range from $8.25 to $10 per 100 lb.

**Nitrate of Soda**—Trade quiet with little spot in first hands available and for close arrivals 95% is held at $3.07½@3.12½ per 100 lb. with futures held at about the same figures. For 96% prices 5@7½ points higher.

**Sulphur**—No relaxation of consumers' demand in sight, slow foreign deliveries responsible for increased demand for domestic product. Spot quoted $35 per long ton, New York, while shipments are bringing $30 at New York and $30.50 at Baltimore.

**Sulphuric Acid**—Demand is reported fair and considerable business said to have been placed on contract. Quotations for 60 deg. acid remain at about $20 per ton and 66 deg. at 1½c. per lb.

### Assessments

| Company | Delinq. | Sale | Amt. |
|---|---|---|---|
| Algomah, Mich. | May 18 | ..... | $1.00 |
| Alta Silver, Nev. | Sept. 1 | Sept. 25 | 0.03 |
| Belmont, Ida. | Aug. 9 | Aug. 26 | 0.006 |
| Challenge, Nev. | Aug. 23 | Sept. 13 | 0.05 |
| Clear Grit, Ida. | Aug. 7 | Aug. 25 | 0.002 |
| Cons. Imperial, Nev. | July 18 | Aug. 10 | 0.01 |
| Cons. Virginia, Nev. | July 27 | Aug. 17 | 0.05 |
| Emerald, Utah | July 15 | Aug. 11 | 0.00½ |
| Friend, Ida. | Aug. 26 | Sept. 16 | 0.002 |
| Four Timbers, Ida. | July 26 | Aug. 26 | 0.002 |
| Gold Mt. Champion, Utah | July 20 | Aug. 10 | 0.0025 |
| Great Bend, Nev. | Aug. 15 | Sept. 20 | 0.01 |
| Great Western, Nev. | July 24 | Aug. 15 | 0.005 |
| Hector, Ida. | Aug. 7 | Sept. 15 | 0.005 |
| Hope, Calif. | July 17 | Aug. 14 | 0.01 |
| Hugo, Ida. | July 29 | Aug. 30 | 0.002 |
| Iron Spar, Ida. | July 17 | Aug. 15 | 0.003 |
| Jacket-C.Point-Belcher, Nev. | Aug. 14 | Sept. 7 | 0.05 |
| Jack Waite, Ida. | July 27 | Aug. 28 | 0.01 |
| Kewanas Reor., Nev. | Aug. 2 | Sept. 6 | 0.01 |
| Keweenaw, Mich. | Sept. 2 | ..... | 1.00 |
| Lehi Tintic, Utah | Aug. 5 | Aug. 25 | 0.0025 |
| Lucky Calumet, Ida. | July 20 | Aug. 21 | 0.005 |
| Nevada-Douglas, Nev. | July 15 | Aug. 16 | 0.10 |
| Nevada Zinc, Nev. | Aug. 14 | Sept. 2 | 0.01 |
| North Lake, Mich. | June 14 | ..... | 1.00 |
| Ophir, Nev. | Aug. 16 | Sept. 6 | 0.05 |
| Rico Argentine, Colo. | Aug. 17 | Sept. 2 | 0.01 |
| Sandstorm Kendall, Nev. | Aug. 22 | Sept. 26 | 0.01 |
| Silver Pick, Nev. | July 5 | Aug. 14 | 0.01 |
| Springfield Tunnel, Calif. | Aug. 15 | ..... | 0.05 |
| Sunrise, Ida. | July 27 | Aug. 28 | 0.002 |
| Sunset, Ida. | Aug. 5 | Aug. 26 | 0.0015 |
| Swansea Ext., Utah | July 10 | Aug. 1 | 0.0025 |
| Tar Baby, Utah | Aug. 3 | Sept. 4 | 0.01 |
| Tarbox, Mont. | July 25 | Aug. 12 | 0.005 |
| Tiberius, Ida. | July 8 | Aug. 1 | 0.001 |
| Tintic Central, Utah | July 12 | Aug. 8 | 0050 |
| Ton. Gypsy Queen, Nev. | July 11 | Aug. 15 | 0.01 |
| Victoria, Utah | July 8 | Aug. 2 | 0.005 |
| Wolf Mt. Copper, Utah | Aug. 2 | Sept. 6 | 0.005 |
| Wonderful, Ida. | Aug. 30 | Sept. 20 | 0.001 |

### Stock Quotations

| SAN FRANCISCO | Aug. 9 |
|---|---|
| Name of Comp. | Bid. |
| Alta | ‡.03 |
| Andes | .08 |
| Best & Belcher | .05 |
| Bullion | .01 |
| Caledonia | .40 |
| Challenge Con. | .03 |
| Confidence | .18 |
| Cons. Imperial | .01 |
| Con. Virginia | .13 |
| Gould & Curry | .03 |
| Hale & Norcross | .06 |
| Jacket-Cr. Pt. | .05 |
| Mexican | .17 |
| Occidental | .70 |
| Ophir | .20 |
| Overman | ‡.04 |
| Savage | .05 |
| Seg Belcher | .02 |
| Sierra Nevada | .30 |
| Union Con. | .68 |
| Utah Con. | .01 |
| Belmont | 4.20 |
| Jim Butler | .89 |
| MacNamara | .05 |
| Midway | .20 |
| Mont.-Tonopah | .23 |
| North Star | .16 |
| Rescue Eula | .25 |
| West End Con. | .82 |
| Atlanta | 09 |
| Blue Bell | .01 |
| Booth | .13 |
| C.O.D. Con | .03 |
| Comb. Frac | .06 |
| D'field B.B. | .02 |
| D'field Daisy | .03 |
| Jumbo Extension | .07 |
| Pitts.-Silver Peak | ‡.12 |
| Round Mountain | .45 |
| Sandstorm Kendall | .04 |
| Silver Pick | .10 |
| Central Eureka | .09 |
| Argo | .10 |
| Ariz. Central | .10 |
| Big Jim | .80 |
| Lazy Boy | .12 |
| Oatman No. Star | ‡.10 |
| Tom Reed | 1.55 |
| United Eastern | 3.62½ |
| United Western | .08 |

| LONDON | July 27 |
|---|---|
| Alaska Tre'dwell | £5 15s 0d |
| Burma Corp. | 3 4 4½ |
| Cam & Motor | 0 10 7½ |
| Camp Bird | 0 8 9 |
| El Oro | 0 9 0 |
| Esperanza | 0 11 6 |
| Mexico Mines | 3 17 6 |
| Nechi, pfd. | 0 15 3 |
| Oroville | 0 17 6 |
| Santa Gert'dis | 0 12 0 |
| Tomboy | 1 2 6 |

| SALT LAKE | Aug. 8 |
|---|---|
| Name of Comp. | Bid. |
| Alta Con. | .21¼ |
| Black Jack | ‡.05½ |
| Colorado Mining | .15 |
| Crown Point | .03½ |
| Daly-Judge | 7.75 |
| Emma Cop. | .54 |
| Gold Chain | .20 |
| Grand Central | .65 |
| Iron Blossom | 1.47½ |
| Lower Mammoth | .03 |
| May Day | .11½ |
| Opohongo | ‡.01½ |
| Prince Con. | 1.47½ |
| Seven Troughs | ‡.03½ |
| Silver King Coal'n | 2.92½ |
| Silver King Con. | 3.22½ |
| Sioux Con. | .09½ |
| Uncle Sam | .06 |
| Yankee | .18½ |

| COLO. SPRINGS | Aug. 8 |
|---|---|
| Acacia | .03¾ |
| Doctor Jack Pot | .09 |
| Elkton Con. | .14½ |
| El Paso | .60 |
| Findlay | .03½ |
| Gold Sovereign | .04 |
| Golden Cycle | 2.07½ |
| Granite | .64 |
| Isabella | .17½ |
| Jack Pot | .05 |
| Jerry Johnson | ‡.03½ |
| Mary McKinney | .29 |
| Portland | 1 5 ¾ |
| Vindicator | 2.— |

| TORONTO | Aug. 8 |
|---|---|
| Adanac | .75 |
| Bailey | .06 |
| Chambers Ferland | .18 |
| Coniagas | 4.30 |
| La Rose | .56½ |
| Peterson Lake | .22 |
| Right of Way | .04 |
| Seneca Superior | .18 |
| T. & Hudson Bay | 55.00 |
| Temiskaming | .58 |
| Trethewey | ‡.21 |
| Wettlaufer-Lor. | .15 |
| Dome Exten. | .34 |
| Dome Lake | .41 |
| Foley O'Brien | .50 |
| Hollinger | 28.90 |
| Jupiter | .25 |
| McIntyre | 1.20 |
| Newray | .46 |
| Porcu. Crown | .70 |
| Preston E. D. | .03 |
| Vipond | .41 |
| West Dome | .39 |

| N. Y. EXCH. | Aug. 8 |
|---|---|
| Name of Comp. | Clg. |
| Alaska Gold M. | 17 |
| Alaska Juneau | 7⅞ |
| Am.Sm.&Ref.,com | 93½ |
| Am. Sm. & Ref., pf. | 111½ |
| Am. Sm. Sec., pf. A | 92⅝ |
| Am. Sm. Sec., pf. B. | 84 |
| Am. Zinc | 32 |
| Am. Zinc, pf | 62½ |
| Anaconda | 80½ |
| Batopilas Min. | 1½ |
| Bethlehem Steel | 424 |
| Bethlehem Steel, pf. | 125 |
| Butte & Superior | 64¼ |
| Chile Cop. | 20 |
| Chino | 48⅛ |
| Colo. Fuel & Iron | 43¾ |
| Crucible Steel | 68 |
| Dome Mines | 25⅛ |
| Federal M. & S. | 13 |
| Federal M. & S., pf. | 35½ |
| Great Nor., ore ctf. | 54⅛ |
| Greene Cananea | 47 |
| Homestake | 130 |
| Inspiration Con. | 48⅞ |
| International Nickel | 44⅛ |
| Kennecott | 46⅛ |
| Lackawanna Steel | 71 |
| Miami Copper | 33⅛ |
| Nat'l Lead, com. | 63⅛ |
| National Lead, pf. | 112⅜ |
| Nev. Consol. | 17 |
| Ontario Min | 6¼ |
| Quicksilver | 2½ |
| Quicksilver, pf | 4½ |
| Ray Con. | 22 |
| Republic I&S, com. | 46½ |
| Republic I&S, pf. | 110 |
| Sloss-Sheffield | 43 |
| Tennessee Copper | 25½ |
| Utah Copper | 78 |
| U. S. Steel, com. | 86⅛ |
| U. S. Steel, pf. | 118⅜ |
| Va. Iron C. & C. | 44 |

| N. Y. CURB | Aug. 8 |
|---|---|
| Beaver Con. | .36 |
| Buffalo Mines | .85 |
| Butte & N. Y. | 1½ |
| Butte C. & Z. | 4½ |
| Caledonia | .65 |
| Can. Cop. Corpn. | 1 1/16 |
| Cashboy | .04 |
| Cerro de Pasco | 34 |
| Con. Ariz. Sm. | 1 7/16 |
| Con. Coppermines | 1⅛ |
| Con. Nev.-Utah | ‡⅛ |
| Crystal Cop. | 1½ |
| First Nat. Cop. | 3⅜ |
| Florence | .75 |
| Goldfield Con. | .83 |
| Goldfield Merger | .07½ |
| Granite | .20 |
| Hecla Min. | 4 15/16 |
| Howe Sound | 4⅛ |
| Jerome Verde | 1½ |
| Joplin Ore & Spel. | .45 |
| Kerr Lake | 4⅛ |
| Magma | 13½ |
| Majestic | 1/16 |
| McKinley-Dar-Sa. | .60 |
| Mother Lode | .30½ |
| Nevada Hills | .15 |
| N. Y. & Hond. | 15½ |
| Nipissing Mines | 6⅞ |
| Oro | .04 |
| Ray Hercules | 3½ |
| Rochester Mines | .58 |
| St. Joseph Lead | 15½ |
| Standard S. L. | 1 1/16 |
| Stewart | .25 |
| Success | .40 |
| Tonopah | 5⅛ |
| Tonopah Ex. | 5⅛ |
| Tribullion | 1/16 |
| United Zinc | 6 |
| White Knob, pf. | 1⅛ |
| White Oaks | 5½ |
| Yukon Gold | 2 1/16 |

| BOSTON EXCH | Aug. 8 |
|---|---|
| Name of Comp. | Bid |
| Adventure | 2½ |
| Ahmeek | 94½ |
| Algomah | 1⅜ |
| Allouez | 59½ |
| Ariz. Com., ctfs. | 8½ |
| Bonanza | .25 |
| Butte-Balaklava | 1½ |
| Calumet & Ariz. | 68½ |
| Calumet & Hecla | 530 |
| Centennial | 15½ |
| Copper Range | 58 |
| Daly West | 2 |
| East Butte | 11½ |
| Franklin | 6½ |
| Granby | 80 |
| Hancock | 10½ |
| Helvetia | .25 |
| Indiana | 2 |
| Island Cr'k, com. | 44 |
| Island Cr'k, pfd. | 88 |
| Isle Royale | 27 |
| Keweenaw | 3½ |
| Lake | 11 |
| La Salle | 3⅜ |
| Mason Valley | 1½ |
| Mass | 10½ |
| Mayflower | 2½ |
| Michigan | 2½ |
| Mohawk | 82 |
| New Arcadian | 4½ |
| New Idria | 11 |
| North Butte | 21 |
| North Lake | 1½ |
| Ojibway | 1½ |
| Old Colony | 1½ |
| Old Dominion | 63 |
| Osceola | 80½ |
| Quincy | 82 |
| St. Mary's M. L. | 70 |
| Santa Fe | 1⅞ |
| Shannon | 7½ |
| Shattuck-Ariz. | 25⅜ |
| So. Lake | 4½ |
| So. Utah | .22 |
| Superior | 14 |
| Superior & Bost. | 3⅛ |
| Tamarack | .34 |
| Trinity | 4½ |
| Tuolumne | .30 |
| U. S. Smelting | 67½ |
| U. S. Smelt'g, pf. | 50½ |
| Utah Apex | 3⅞ |
| Utah Con. | 13 |
| Utah Metal | 7⅜ |
| Victoria | 2½ |
| Winona | 4½ |
| Wolverine | 47½ |
| Wyandot | 1 |

| BOSTON CURB | Aug. 8 |
|---|---|
| Bingham Mines | 89½ |
| Boston Ely | .95 |
| Boston & Mont. | .83 |
| Butte & Lon'n Dev. | .56 |
| Calaveras | 5 |
| Calumet-Corbin | .02 |
| Chief Con. | 1 1/16 |
| Cortez | .30 |
| Crown Reserve | .45 |
| Davis-Daly | 1 1/16 |
| Eagle & Blue Bell | 1⅛ |
| Houghton Copper | 1⅛ |
| Iron Cap Cop., pf. | 6 |
| Mexican Metals | .27 |
| Mines of America | 2⅛ |
| Mojave Tungsten | 3⅛ |
| Nat. Zinc & Lead | 1 1/16 |
| Nevada-Douglas | 1 |
| New Baltic | 1⅛ |
| New Cornelia | 15 |
| Ohio Copper | .08 |
| Oneco | .80 |
| Raven Copper | .05 |
| Rex Cons. | .18 |
| Rilia | .17 |
| United Verde Ext. | 31⅛ |

‡Last Quotations.

### Monthly Average Prices of Metals

SILVER

| Month | New York | | | London | | |
|---|---|---|---|---|---|---|
| | 1914 | 1915 | 1916 | 1914 | 1915 | 1916 |
| January | 56.572 | 48.855 | 56.775 | 26.553 | 22.731 | 26.960 |
| February | 57.506 | 48.477 | 56.755 | 26.573 | 22.753 | 26.975 |
| March | 58.067 | 50.241 | 57.935 | 26.788 | 23.708 | 27.597 |
| April | 58.519 | 50.250 | 64.415 | 26.958 | 23.709 | 30.662 |
| May | 58.175 | 49.915 | 74.269 | 26.704 | 23.570 | 35.477 |
| June | 56.471 | 49.034 | 65.024 | 25.948 | 23.267 | 31.060 |
| July | 54.678 | 47.519 | 62.940 | 25.219 | 22.597 | 30.000 |
| August | 54.344 | 47.163 | ..... | 25.979 | 22.780 | ..... |
| September | 53.290 | 48.680 | ..... | 24.260 | 23.591 | ..... |
| October | 50.654 | 49.385 | ..... | 23.199 | 23.925 | ..... |
| November | 49.082 | 51.714 | ..... | 22.703 | 25.094 | ..... |
| December | 49.375 | 54.971 | ..... | 22.900 | 26.373 | ..... |
| Year | 54.811 | 49.684 | ..... | 25.314 | 23.675 | ..... |

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

| Month | New York Electrolytic | | London Standard | | London Electrolytic | |
|---|---|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 | 1915 | 1916 |
| Jan. | 13.641 | 24.008 | 60.756 | 88.083 | 65.719 | 116.167 |
| Feb. | 14.394 | 26.440 | 63.494 | 102.667 | * | 133.167 |
| Mar. | 14.787 | 26.310 | 66.152 | 107.714 | * | 136.000 |
| April | 16.811 | 27.895 | 75.096 | 124.319 | * | 137.389 |
| May | 18.506 | 28.625 | 77.600 | 135.457 | * | 152.522 |
| June | 19.477 | 26.601 | 82.574 | 112.432 | 95.333 | 137.455 |
| July | 18.796 | 23.865 | 76.011 | 95.119 | 91.409 | 125.500 |
| Aug. | 16.941 | ..... | 68.673 | ..... | 82.333 | ..... |
| Sept. | 17.502 | ..... | 68.915 | ..... | 85.250 | ..... |
| Oct. | 17.686 | ..... | 72.601 | ..... | 88.000 | ..... |
| Nov. | 18.627 | ..... | 77.744 | ..... | 93.273 | ..... |
| Dec. | 20.133 | ..... | 80.773 | ..... | 100.43 | ..... |
| Year | 17.275 | ..... | 72.532 | ..... | ..... | ..... |

TIN

| Month | New York | | London | |
|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 |
| January | 34.260 | 41.825 | 156.550 | 175.548 |
| February | 37.415 | 42.717 | 176.925 | 181.107 |
| March | 48.426 | 50.741 | 180.141 | 193.609 |
| April | 47.884 | 51.230 | 166.225 | 199.736 |
| May | 38.790 | 49.125 | 162.675 | 196.511 |
| June | 40.288 | 42.231 | 167.636 | 179.466 |
| July | 37.423 | 38.510 | 167.080 | 168.357 |
| August | 34.389 | ..... | 151.440 | ..... |
| September | 33.125 | ..... | 152.625 | ..... |
| October | 33.080 | ..... | 151.554 | ..... |
| November | 39.224 | ..... | 167.670 | ..... |
| December | 38.779 | ..... | 167.000 | ..... |
| Av. year | 38.590 | ..... | 163.960 | ..... |

LEAD

| Month | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 | 1915 | 1916 |
| January | 3.729 | 5.921 | 3.548 | 5.826 | 18.606 | 31.167 |
| February | 3.827 | 6.246 | 3.718 | 6.164 | 19.122 | 31.988 |
| March | 4.053 | 7.136 | 3.997 | 7.375 | 21.883 | 34.440 |
| April | 4.221 | 7.630 | 4.142 | 7.655 | 21.094 | 34.368 |
| May | 4.274 | 7.463 | 4.182 | 7.332 | 20.347 | 32.967 |
| June | 5.932 | 6.936 | 5.836 | 6.749 | 25.170 | 31.011 |
| July | 5.659 | 6.352 | 5.531 | 6.185 | 24.611 | 28.137 |
| August | 4.656 | ..... | 4.520 | ..... | 21.946 | ..... |
| September | 4.610 | ..... | 4.490 | ..... | 23.151 | ..... |
| October | 4.600 | ..... | 4.499 | ..... | 23.994 | ..... |
| November | 5.155 | ..... | 5.078 | ..... | 26.278 | ..... |
| December | 5.355 | ..... | 5.266 | ..... | 28.807 | ..... |
| Year | 4.673 | ..... | 4.567 | ..... | 22.917 | ..... |

SPELTER

| Month | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 | 1915 | 1916 |
| Jan. | 6.386 | 16.915 | 6.211 | 16.745 | 30.844 | 89.810 |
| Feb. | 8.436 | 18.420 | 8.255 | 18.260 | 39.819 | 97.762 |
| Mar. | 8.541 | 16.846 | 8.360 | 16.676 | 44.141 | 95.048 |
| April | 10.012 | 16.695 | 9.837 | 16.525 | 49.888 | 99.056 |
| May | 14.781 | 14.276 | 14.610 | 14.106 | 68.100 | 94.217 |
| June | 21.208 | 11.752 | 21.038 | 11.582 | 100.614 | 68.591 |
| July | 19.026 | 8.925 | 18.856 | 8.755 | 97.250 | 50.750 |
| Aug. | 12.781 | ..... | 12.611 | ..... | 67.786 | ..... |
| Sept. | 13.440 | ..... | 13.270 | ..... | 67.841 | ..... |
| Oct. | 12.800 | ..... | 12.596 | ..... | 66.536 | ..... |
| Nov. | 15.962 | ..... | 15.792 | ..... | 88.409 | ..... |
| Dec. | 15.391 | ..... | 15.221 | ..... | 89.400 | ..... |
| Year | 13.230 | ..... | 13.054 | ..... | 67.553 | ..... |

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported.

PIG IRON IN PITTSBURGH

| Month | Bessemer‡ | | Basic‡ | | No. 2 Foundry | |
|---|---|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 | 1915 | 1916 |
| January | $14.59 | $21.60 | $13.45 | $18.78 | $13.90 | $19.70 |
| February | 14.55 | 21.16 | 13.45 | 18.93 | 13.90 | 19.51 |
| March | 14.55 | 21.81 | 13.45 | 19.20 | 13.95 | 19.45 |
| April | 14.55 | 21.65 | 13.45 | 18.95 | 13.95 | 19.45 |
| May | 14.61 | 21.78 | 13.60 | 19.11 | 13.83 | 19.58 |
| June | 14.70 | 21.95 | 13.67 | 18.95 | 13.77 | 19.34 |
| July | 14.94 | 21.95 | 13.91 | 18.95 | 13.68 | 19.20 |
| August | 16.01 | ..... | 15.31 | ..... | 14.75 | ..... |
| September | 16.86 | ..... | 15.95 | ..... | 15.70 | ..... |
| October | 16.95 | ..... | 15.96 | ..... | 15.80 | ..... |
| November | 17 57 | ..... | 16.47 | ..... | 17.20 | ..... |
| December | 19.97 | ..... | 18.44 | ..... | 18.95 | ..... |
| Year | $15.82 | ..... | $14.76 | ..... | $14.95 | ..... |

‡As reported by W. P. Snyder & Co.